MODEL

# HW-2021 2-Meter Hand-Held Transceiver

# HEATHKIT®

## ASSEMBLY MANUAL

HEATH COMPANY . BENTON HARBOR, MICHIGAN

HEATHKIT®



PRICE $2.00

I-595-1742

## HEATH COMPANY PHONE DIRECTORY

The following telephone numbers are direct lines to the departments listed:

| | |
|---|---|
| Kit orders and delivery information | (616) 982-3411 |
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| Replacement Parts | (616) 982-3571 |
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## YOUR HEATHKIT 90-DAY FULL WARRANTY

During your first ninety (90) days of ownership, Heath Company will replace or repair free of charge — as soon as practical — any parts which are defective, either in materials or workmanship. You can obtain parts directly from Heath Company by writing us or telephoning us at (616) 982-3571. And we'll pay shipping charges to get those parts to you — anywhere in the world.

We warrant that, during the first ninety (90) days of ownership, our products, when correctly assembled, calibrated, adjusted, and used in accordance with our printed instructions, will meet published specifications.

If a defective part or error in design has caused your Heathkit product to malfunction during the warranty period, through no fault of yours, we will service it free upon delivery at your expense to the Heath factory, Benton Harbor, Michigan, or to any Heathkit Electronic Center (units of Schlumberger Products Corporation), or through any of our authorized overseas distributors.

You will receive free consultation on any problem you might encounter in the assembly or use of your Heathkit product. Just drop us a line or give us a call. Sorry, we cannot accept collect calls.

Our warranty, both express and implied, does not cover damage caused by use of corrosive solder, defective tools, incorrect assembly, misuse, fire, customer-made modifications, flood or acts of God, nor does it include re-imbursement for customer assembly or set-up time. The warranty covers only Heath products and is not extended to non-Heath allied equipment or components used in conjunction with our products or uses of our products for purposes other than as advertised.

And if you are dissatisfied with our service — warranty or otherwise — or our products, write directly to our Director of Customer Services, Heath Company, Benton Harbor, Michigan, 49022. Telephone (616) 982-3524. He'll make certain your problems receive immediate, personal attention.

HEATH COMPANY
BENTON HARBOR, MI. 49022

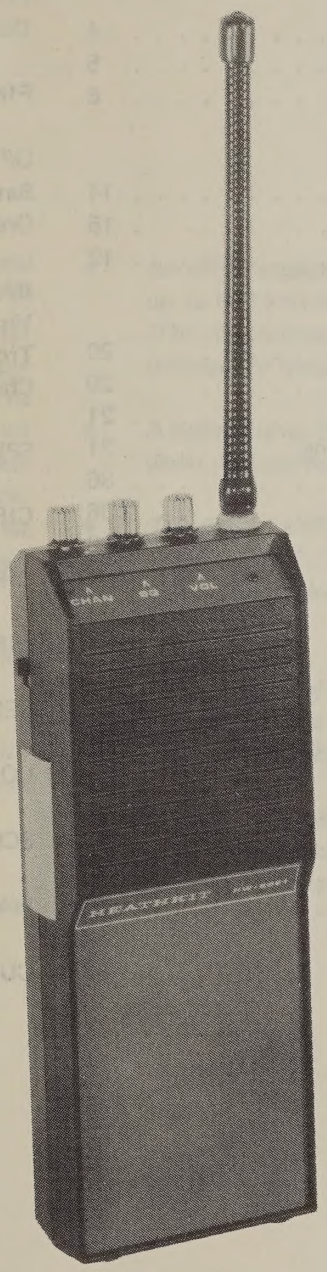
Prices and specifications subject to change without notice.

# Assembly and Operation of the

HEATHKIT®

# 2-METER HAND-HELD TRANSCEIVER

## MODEL HW-2021





HEATH COMPANY
BENTON HARBOR, MICHIGAN 49022

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# INTRODUCTION

The Heathkit Model HW-2021 2-Meter Hand-Held Transceiver is a 1-watt, solid-state, narrow-band FM transceiver with five simplex channels and five repeater channels. Crystals for 146.94 MHz simplex and the 146.34/146.94 MHz repeater channel are furnished. The Transceiver is designed for portable use and is supplied with rechargeable, AA size, nickel-cadmium batteries. A separate transformer charger is supplied to charge the battery pack. The Transceiver can be aligned without special test equipment, although an alignment procedure using test instruments is included in this Manual.

The following features are also included in this high quality transceiver:

- A dual-gate MOSFET "front end" helps minimize front end overloading and adjacent channel interference.
- The same crystal is used for receive and transmit.
- An offset capability permits the transmitter to operate up to 600 kHz below or above the receiver frequency. (The transmitter crystal that operates 600 kHz below the receiver frequency is supplied.)
- A battery saver circuit helps to conserve battery power when the receiver section is squelched.
- 0.5 watts of audio is available.
- A jack is provided so you can use an optional external antenna.

Both mobile and fixed station antennas for your Transceiver are available from the Heath Company. If you want more power, a 2-meter amplifier is also available.

*Refer to the "Kit Builders Guide" for information on unpacking, parts identification, tools, wiring, soldering, and step-by-step assembly procedures.*

# PARTS LIST

The Battery Charger parts and the Transceiver parts are both included in this Parts List. Check the "Battery Charger Parts" first and keep them separate. Then check each of the remaining parts in the carton against the "Transceiver Parts List." The key numbers correspond to the numbers in the Parts Pictorial. Make a check (✓) in the space provided as you identify each part. The parts may vary slightly from the illustrations. Only the hardware is drawn to actual size.

Some parts are packaged in envelopes with the part number of the contents printed on the outside. Except for the initial parts check, keep these parts in their envelopes so they can be easily identified when they are called for in the assembly steps.

To order a replacement part, always include the Part Number and use the Parts Order Form furnished with this kit. If a Parts Order Form is not available, see "Replacement Parts" inside the rear cover of this Manual. Your Warranty is located inside the front cover.

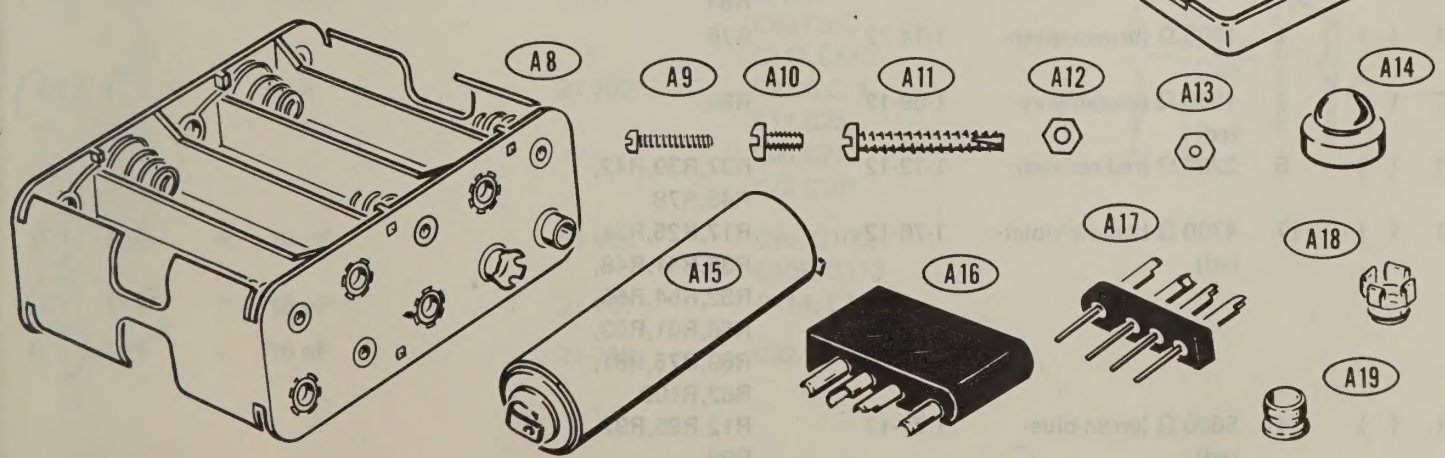
Each circuit part in this kit has its own component number (R2, C4, etc.). Use these numbers when you want to positively identify the same part in the various sections of this Manual. These numbers, which are especially useful if a part has to be replaced, appear:

- In the Parts List,
- At the beginning of each step where a component is installed,
- In some illustrations,
- In the Schematic,
- In the sections at the rear of this Manual.

# BATTERY CHARGER PARTS

NOTE: All the small battery charger parts are packed in a bag marked "Part of pack #1."

| KEY No. | QTY. | DESCRIPTION | PART No. | CIRCUIT Component No. |
|---|---|---|---|---|
| A1 | 1 | .22 µF Mylar* capacitor | 27-130 | C301 |
| A2 | 1 | Power transformer | 54-830 | T301 |
| A3 | 4 | 1N2071 diode | 57-27 | D301, D302, D303, D304 |
| | 1 | Insulating paper | 75-109 | |
| A4 | 1 | Connector housing top | 75-184 | |
| A5 | 1 | Connector housing bottom | 75-185 | |
| | 1 | Battery charger circuit board | 85-1617 | |
| | 1 | Power cord w/plug | 89-44 | |
| A6 | 1 | Charger top | 92-84 | |
| A7 | 1 | Charger base | 92-85 | |
| A8 | 1 | Battery housing | 214-190 | |
| A9 | 2 | 2-56 x 3/8" fillister head screw | 250-421 | |
| A10 | 1 | 4-40 x 3/16" screw | 250-366 | |
| A11 | 4 | #4 x 3/4" self-tapping screw | 250-477 | |
| A12 | 1 | 4-40 nut | 252-15 | |
| A13 | 2 | 2-56 nut | 252-51 | |
| A14 | 4 | Rubber foot | 261-1 | |
| A15 | 10 | Battery cell | 418-32 | |
| A16 | 1 | 4-pin connector socket | 432-103 | S301 |
| A17 | 1 | 4-pin connector plug | 432-104 | P301 |
| A18 | 1 | Female battery connector | 432-894 | |
| A19 | 1 | Male battery connector | 432-895 | |
| | 1 | Power label | 390-1221 | |




*DuPont Registered Trademark

# TRANSCEIVER PARTS

| KEY No. | | QTY. | DESCRIPTION | PART No. | CIRCUIT Component No. |
|---|---|---|---|---|---|

## RESISTORS

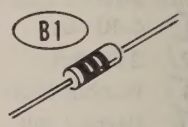
NOTES:

1. The resistors may be packed in more than one envelope. Open all resistor envelopes in this pack before you check them against the Parts List.

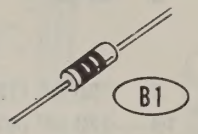
2. The following resistors have a tolerance of 5% unless they are listed otherwise. 5% is indicated by a fourth color band of gold; 10% is indicated by a silver band.

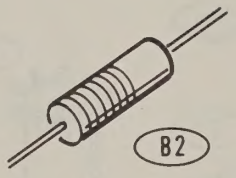
### 1/4-Watt

| | | | | | |
|---|---|---|---|---|---|
| B1 | ( ) | 3 | 10 Ω (brown-black-black) | 1-55-12 | R3, R14, R103 |
| B1 | ( ) | 1 | 33 Ω, 10% (orange-orange-black) | 1-20-12 | R104 |
| B1 | ( ) | 1 | 47 Ω (yellow-violet-black) | 1-58-12 | R21 |
| B1 | ( ) | 5 | 100 Ω (brown-black-brown) | 1-60-12 | R13, R18, R67, R71, R101 |
| B1 | ( ) | 6 | 220 Ω (red-red-brown) | 1-62-12 | R4, R8, R74, R94, R97, R201 |
| B1 | ( ) | 1 | 330 Ω (orange-orange-brown) | 1-92-12 | R27 |
| B1 | ( ) | 1 | 470 Ω (yellow-violet-brown) | 1-35-12 | R19 |
| B1 | ( ) | 1 | 680 Ω, 10% (blue-gray-brown) | 1-40-12 | R64 |
| B1 | ( ) | 7 | 1000 Ω (brown-black-red) | 1-69-12 | R22,R23,R45, R47,R49,R79, R89 |
| B1 | ( ) | 1 | 1500 Ω (brown-green-red) | 1-71-12 | R76 |
| B1 | ( ) | 1 | 1800 Ω (brown-gray-red) | 1-99-12 | R86 |
| B1 | ( ) | 5 | 2200 Ω (red-red-red) | 1-72-12 | R37,R39,R42, R43,R78 |
| B1 | ( ) | 17 | 4700 Ω (yellow-violet-red) | 1-76-12 | R17,R25,R31, R36,R41,R48, R52,R54,R56, R58,R61,R63, R69,R75,R81, R82,R102 |
| B1 | ( ) | 4 | 5600 Ω (green-blue-red) | 1-77-12 | R12,R85,R92, R99 |



| KEY No. | | QTY. | DESCRIPTION | PART No. | CIRCUIT Component No. |
|---|---|---|---|---|---|
| **Resistors (cont'd.)** | | | | | |
| B1 | ( ) | 1 | 8200 Ω, 10% (gray-red-red) | 1-28-12 | R15 |
| B1 | ( ) | 10 | 10 kΩ (brown-black-orange) | 1-80-12 | R24, R28, R32, R33, R38, R44, R51, R66, R73, R96 |
| B1 | ( ) | 2 | 12 kΩ, 10% (brown-red-orange) | 1-14-12 | R2, R6 |
| B1 | ( ) | 2 | 18 kΩ (brown-gray-orange) | 1-94-12 | R34, R35 |
| B1 | ( ) | 2 | 22 kΩ (red-red-orange) | 1-91-12 | R46, R98 |
| B1 | ( ) | 2 | 33 kΩ (orange-orange-orange) | 1-82-12 | R68, R77 |
| B1 | ( ) | 9 | 47 kΩ (yellow-violet-orange) | 1-83-12 | R1, R5, R7, R9, R11, R16, R65, R72, R95 |
| B1 | ( ) | 9 | 100 kΩ (brown-black-yellow) | 1-84-12 | R53, R55, R57, R59, R62, R88, R91, R93, R401 |
| B1 | ( ) | 1 | 1 MΩ (brown-black-green) | 1-87-12 | R83 |



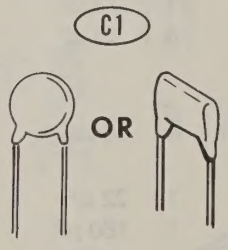




**1-Watt**

| | | | | | |
|---|---|---|---|---|---|
| B2 | ( ) | 1 | 51 Ω (green-brown-black) | 1-43-1 | Dummy load |

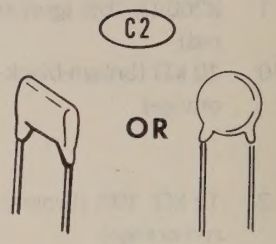
## CAPACITORS

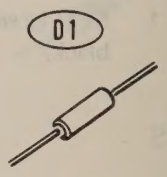
**Ceramic**

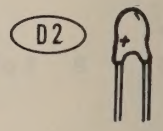



| | | | | | |
|---|---|---|---|---|---|
| C1 | ( ) | 6 | 3.3 pF | 21-701 | C7,C13, C68,C98, C111,C116 |
| C1 | ( ) | 9 | 5 pF | 21-702 | C2,C6,C11, C17,C25, C66,C71, C73,C101 |
| C1 | ( ) | 4 | 10 pF | 21-705 | C95, C106, C108, C113 |
| C1 | ( ) | 2 | 15 pF | 21-707 | C114, C115 |
| C1 | ( ) | 1 | 20 pF | 21-718 | C92 |

| KEY No. | | QTY. | DESCRIPTION | PART No. | CIRCUIT Component No. |
|---|---|---|---|---|---|
| **Ceramic Capacitors (cont'd.)** | | | | | |
| C2 | (✓) | 3 | 36 pF | 21-709 | C16, C28, C87 |
| C2 | (✓) | 9 | 47 pF | 21-710 | C19, C35, C57, C61, C62, C89, C96, C103, C105 |
| C2 | (✓) | 3 | 150 pF (151) | 21-715 | C22, C59, C88 |
| C2 | (✓) | 19 | 470 pF (471) | 21-711 | C1, C3, C4, C5, C8, C9, C56, C64, C67, C72, C75, C76, C81, C97, C99, C102, C104, C107, C109 |
| C2 | (✓) | ~~26~~ 24 | .01 µF (103) | 21-717 | C14, C15, C21, C23, C24, C26, C27, C31, C32, ~~C38, C43,~~ C44, C45, C46, C47, C48, C58, C63, C65, C69, C74, C83, C86, C91, C93, C402 |
| C2 | (✓) | 2 | .047 µF (473) | 21-182 | C33, C79 |
| C2 | (✓) | 1 | .1 µF (104) | 21-187 | C42 |
| C2 | (✓) | 1 | 100 pF | 21-9 | C201 |
| **Tantalum** | | | | | |
| D1 | (✓) | 1 | .22 µF | 25-210 | C78 |
| D2 | (✓) | 6 | .68 µF | 25-200 | C29, C34, C77, C82, C84, C85 |
| D2 | (✓)(✓) | ~~5~~ 4 | 10 µF | 25-220 | C12, C36, C43, C37, C112 |
| D2 | (✓) | 1 | 22 µF | 25-212 | C39 |
| D2 | (✓) | 1 | 150 µF | 25-814 | C41 |
| D2 | (✓) | 1 | 47 µF | 25-223 | C38 |



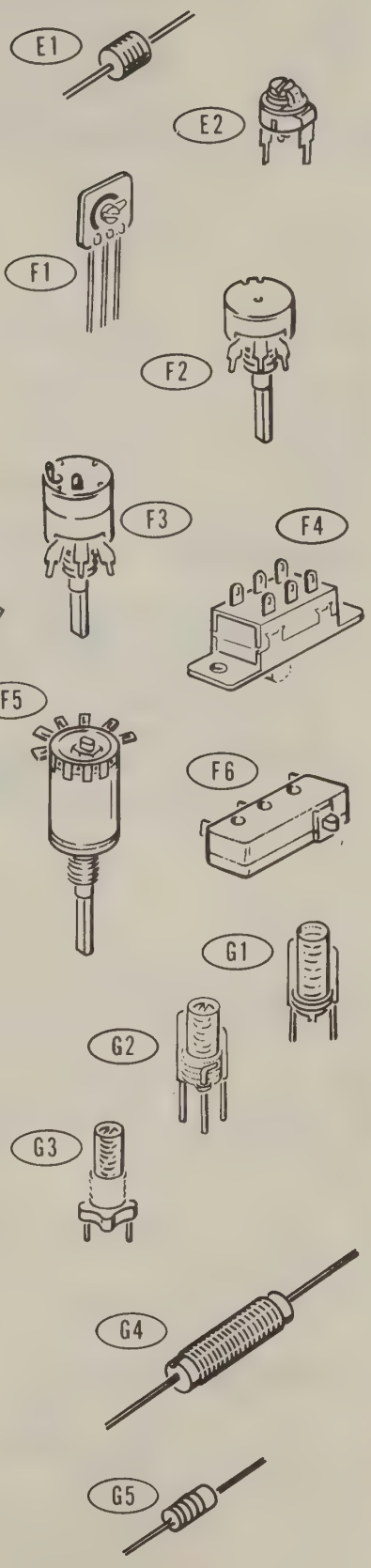



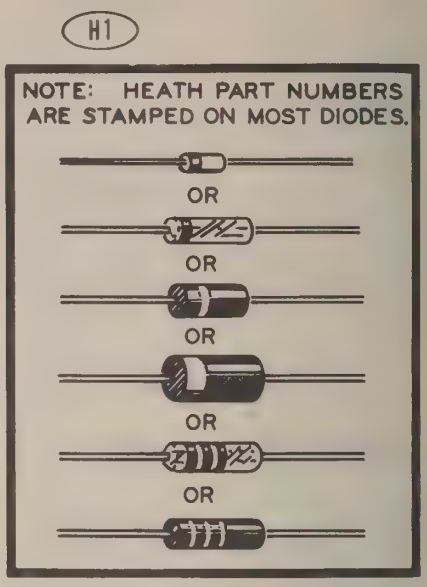

Note: 2 .01 µF (103) Cap left over

| KEY No. | QTY. | DESCRIPTION | PART No. | CIRCUIT Component No. |
|---|---|---|---|---|
| **Others** | | | | |
| E1 | 1 | .56 pF phenolic (green-blue-gray-silver) | 28-3 | C94 |
| E1 | 2 | 2.2 pF phenolic (red-red-white) | 28-1 | C18, C401 |
| E2 | 5 | 3.2-18 pF trimmer | 31-71 | C49, C51, C52, C53, C54 |
| **CONTROLS-SWITCHES** | | | | |
| F1 | 1 | 10 kΩ control | 10-1039 | R85 |
| F2 | 1 | 5 kΩ control | 10-1040 | R26 |
| F3 | 1 | 5 kΩ control with switch | 19-714 | R29/SW2 |
| F4 | 1 | Slide switch | 60-602 | SW3 |
| F5 | 1 | Rotary switch | 63-1235 | SW201 |
| F6 | 1 | Pushbutton switch | 64-23 | SW1 |
| **COILS-CHOKES** | | | | |
| G1 | 1 | .08 µH coil (brown, 1-1/2 turns) | 40-1838 | L19 |
| G1 | 4 | .10 µH coil (red) | 40-1784 | L11,L15,L16,L18 |
| G1 | 1 | .30 µH coil (violet) | 40-1785 | L7 |
| G1 | 3 | .12 µH coil (orange, 3-1/2 turns) | 40-1782 | L9,L17,L22 |
| G1 | 7 | .15 µH coil (yellow) | 40-1783 | L2,L3,L8,L12, L13,L14,L21 |
| G2 | 1 | .15 µH coil with tap (yellow) | 40-1781 | L1 |
| G3 | 2 | 7.5 µH coil | 40-1814 | L4,L5 |
| G4 | 1 | 15 µH coil | 45-51 | L6 |
| G5 | 7 | 1 mH choke (brown-black-red) | 45-80 | RFC1,RFC2,RFC3, RFC4,RFC5,RFC6, RFC7 |

CHANGE
Remove Nut + Lockwasher + Discard.



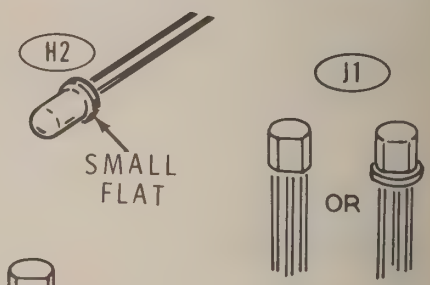
| KEY No. | | QTY. | DESCRIPTION | PART No. | CIRCUIT Component No. |
|---|---|---|---|---|---|
| **DIODES** | | | | | |
| H1 | ( ) | 8 | 1N458 | 56-24 | D8,D9,D10 D11,D12,D13, D14,D15 |
| H1 | ( ) | 5 | 1N4149 | 56-56 | D3,D4,D5, D6,D7 |
| H1 | ( ) | 1 | 1N191 (brown-white-brown) | 56-26 | D401 |
| H1 | ( ) | 1 | VRS-5A zener | 56-54 | ZD201 |
| H1 | ( ) | 1 | MV1404 varactor | 56-632 | VD1 |
| H1 | ( ) | 2 | 1N2071 | 57-27 | D1, D2 |
| H2 | ( ) | 1 | TIL209 LED lamp | 412-79 | LED201 |



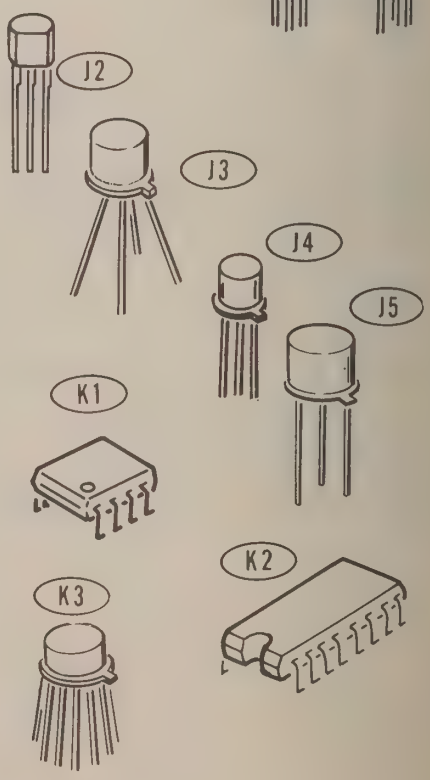

## TRANSISTORS

NOTE: Transistors and integrated circuits are marked for identification in one of the following four ways.

1. Part number.
2. Type number.
3. Part number and type number.
4. Part number with a type number other than the one listed.




| | | | | | |
|---|---|---|---|---|---|
| J1 | ( ) | 7 | 2N3393 | 417-118 | Q5, Q6, Q7, Q8, Q9, Q10, Q13 |
| J1 | ( ) | 1 | X29A829 | 417-201 | Q11 |
| J1 | ( ) | 1 | 2N5308 | 417-222 | Q14 |
| J2 | ( ) | 4 | MPS6520 | 417-134 | Q4,Q16, Q17,Q18 |
| J2 | ( ) | 1 | MPS6521 | 417-172 | Q15 |
| J2 | ( ) | 1 | MPF105 | 417-169 | Q19 |
| J3 | ( ) | 1 | UC734 | 417-167 | Q20 |
| J3 | ( ) | 4 | 40673 | 417-240 | Q1,Q2, Q3,Q21 |
| J4 | ( ) | 5 | 2N2369 | 417-154 | Q12,Q22,Q23, Q24,Q25 |
| J5 | ( ) | 1 | 2N5913 or PT8831 | 417-850 | Q26 |




## INTEGRATED CIRCUITS

| | | | | | |
|---|---|---|---|---|---|
| K1 | ( ) | 1 | N5741 operational amplifier | 442-22 | IC3 |
| K2 | ( ) | 1 | CA-3089 IF amplifier/detector | 442-92 | IC1 |
| K3 | ( ) | 1 | MC1454 audio amplifier | 442-97 | IC2 |

HEATH
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HEATH COMPANY
BENTON HARBOR, MICHIGAN 49022
TLX 72-9421

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| Automotive, Marine, Home Security, CB, Shortwave, Metal Locators, and all General Products | 616-982-3496 |
| REPLACEMENT PARTS, call | 616-982-3571 |

MR. A. HULETT
BOX 338
CHARLESTON MISS 38921

Dear Customer:

Subject: HW-2021

Thanks for your inquiry regarding your HW-2021 handheld Two Meter Transceiver.

If the blue label series number for your HW-2021 is 00544, please make the changes described on the attached list of instructions. After you have completed the changes, your transceiver will have improved receiver and squelch sensitivity and the transmitter will easily exceed specified power output.

Please take particular care when you install each of the new components. After making the changes, recheck your assembly for the following:

1. Proper location of each component.
2. Proper installation of each component.
3. Any solder bridges between foil pads
4. Bright and clean solder connections.

All necessary components for this change are being sent to you free of charge. One suggestion...before you install a component, use the "solder wick" supplied with your transceiver to remove solder from the circuit board holes.

Should you have any questions, please contact Heath's Amateur Radio consultants...phone number (616) 982-3296. They'll be glad to help you.

Thanks again for yourcontinued interest in Heath products.

Best 73's,

Ed Mosher

21 July 71

Heath Company
Technical Consultation Department

Tel

sd

HW-2021
Hand Held Transceiver

## APPROVED CHANGES FOR IMPROVED TRANSCEIVER PERFORMANCE

Please make the following changes to your HW-2021, only if the blue label series number is 00544.

1. Change:

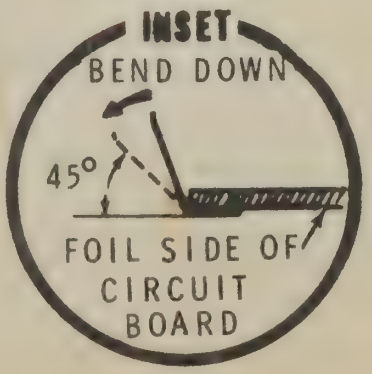
| | | | | |
|---|---|---|---|---|
| R63 | from | 4.7K | to | 1-78-12 (6.8K) |
| C64 | from | 470 pf | to | 21-710 (47 pf) |
| C57 | from | 47 pf | to | 20-76 (68 pf) |
| C103 | from | 47 pf | to | 21-111 (15 pf) |
| C67 | from | 470 pf | to | 21-710 (47 pf) |
| R64 | from | 680 Ohm | to | 1-2-12 (1K) |
| R65 | from | 47K | to | 1-32-12 (~~100K~~) 330K |
| R21 | from | 47 Ohm | to | 45-80 (1 mh choke) |
| Q16 | from | 417-134 | to | 417-293 |
| Q1, Q2 | from | 417-240 | to | 417-274 |

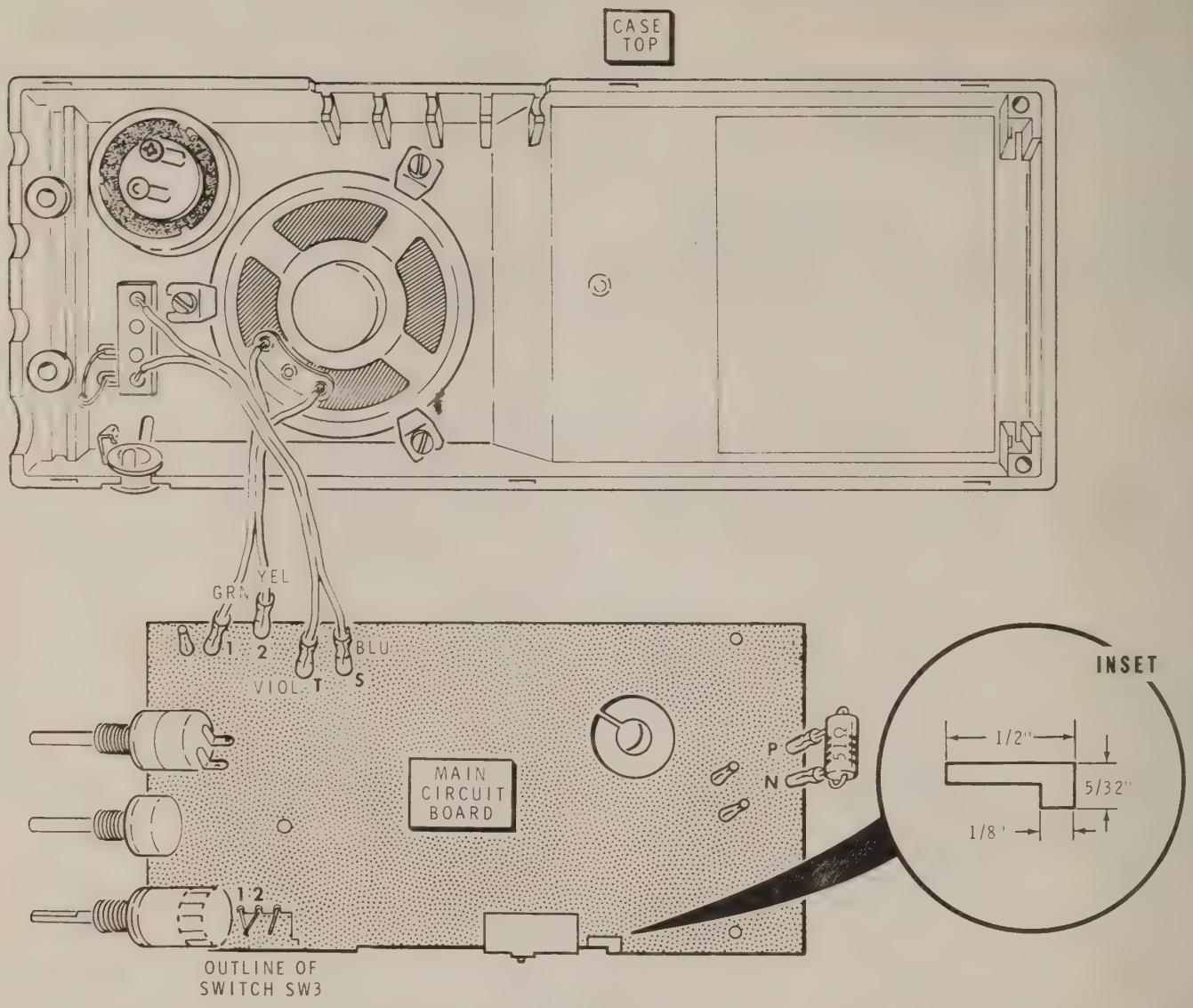
10Ω R

2. Remove C72 from the circuit. It will not be replaced.
   ~ 470pF (21-711)
3. Use a short piece of wire to connect 1C1 pin 4 and 14 together, taking care not to touch other foils.
4. Remove the 6 1/2" grey wire from terminal 3 of the push-to-talk switch and the B+ hole on the circuit board. Replace this lead with a 2 1/4" grey lead from the B+ hole to the common junction of R24 and R28. Make this lead as short and direct as possible.
5. Install a 258-5 spring clip at the upper right hand corner of the circuit board (see drawing below). The clip should be arranged so that it will touch the case side when the board is installed.

After making these changes, the units will have improved squelch and receiver sensitivity and the transmitter will easily exceed specified power output.

* These should be the parts you received




**PICTORIAL 3-2**

# TRANSCEIVER CIRCUIT BOARD

I.

NOTE: The purpose of this modification is to prevent the PTT switch actuator from shorting part of the main circuit board foil.

Refer to the new Pictorial 3-2 of these Instructions for the following two steps.

( ) Cut a piece of insulating paper with the dimensions given in the inset drawing, from the 1″×1″ piece supplied with these Instructions.

( ) Peel off the backing paper from the insulating paper. Then press the insulating paper into place on the transceiver circuit board at the location shown.

II.

NOTE: Red-colored diodes at locations D14 and D15 on the main circuit board may have been supplied in error.

( ) Locate diodes D14 and D15 on the main circuit board. If the color of these diodes is red, complete the next steps. If their color is blue, however, disregard these steps.

NOTE: After you install and solder each component in the following steps, cut off and discard the excess lead lengths.

( ) Remove the red-colored diode at D14.

( ) Install a 1N458 diode (#56-24, BLUE) at D14.

( ) Remove the red-colored diode at D15.

( ) Install a 1N458 diode (#56-24, BLUE) at D15.

III.

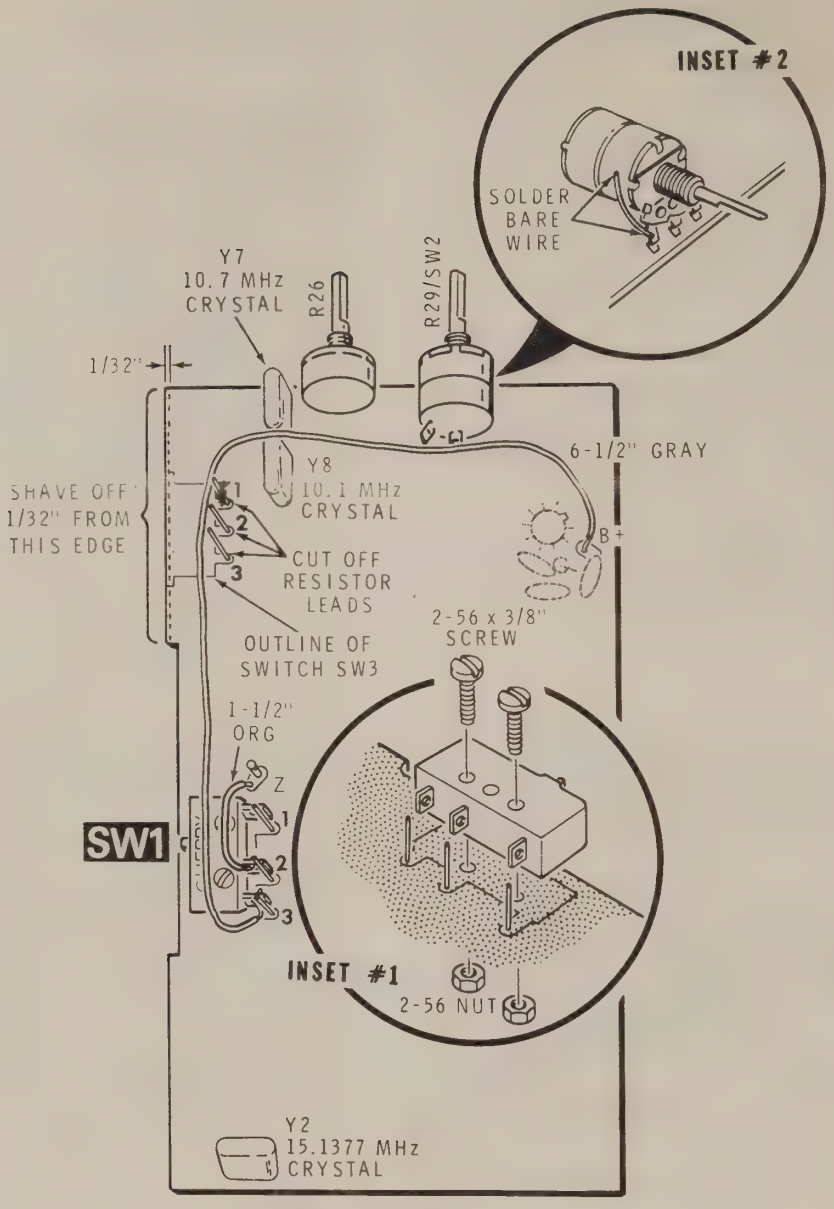
Page 51 - Left column, eighth step. Perform the following step if you do not obtain the voltmeter reading given.

( ) Remove the MPS6520 transistor (#417-134) at Q17.

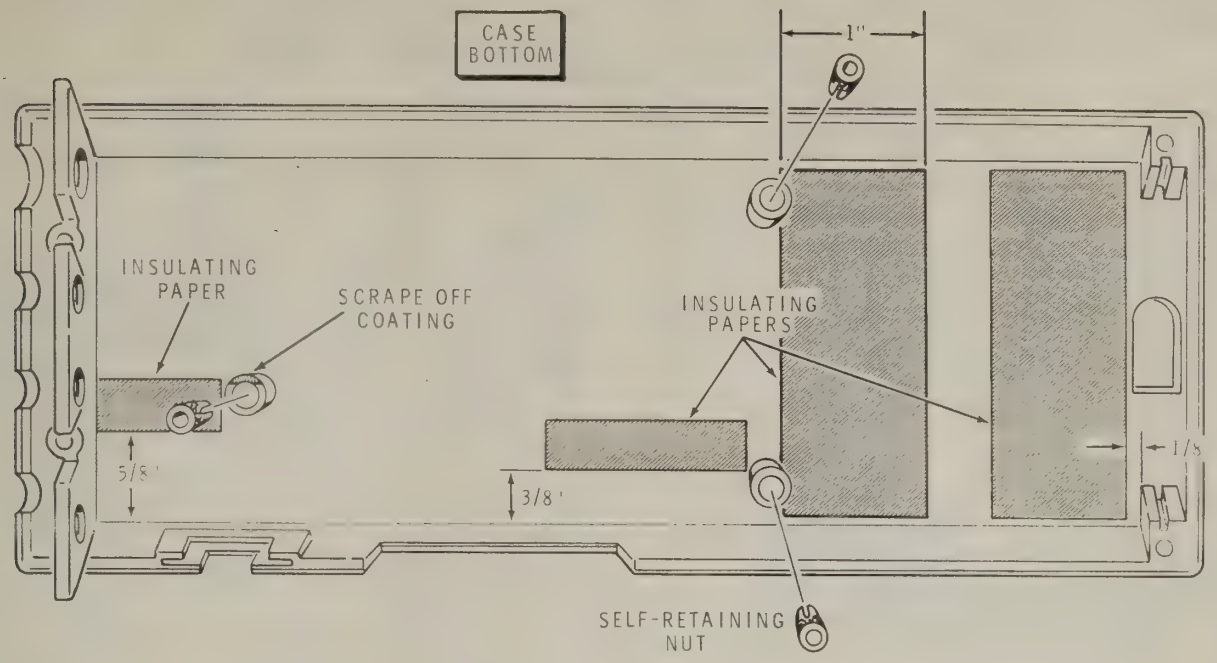
( ) Install a 2N5770 transistor (#417-293) at Q17.

( ) Remove the MPS6520 transistor (#417-134) at Q18.

( ) Install a 2N5770 transistor (#417-293) at Q18.




**PICTORIAL 2-16**




## PICTORIAL 4-1

IV.

Page 55 - Left column, first step. Perform the next two steps if the larger holes in the main circuit board do not line up with the self-retaining nuts in the case bottom.

( ) Refer to the new Pictorial 2-16 and, using a fine file, "shave off" about 1/32" from the edge of the circuit board at the location shown.

( ) Refer to the new Pictorial 4-1 and, using a pen knife, scrape off a 1/16"-wide segment of the conductive coating from the top of the indicated boss in the case bottom.

V.

If no sound is coming from the speaker and the LED does not light when the Squelch control is turned fully counterclockwise, transistor Q12 is probably defective. NOTE: You should have a low pulsating voltage at B (base) of transistor Q13 when Q12 is functioning properly. Perform the following five steps if you have determined that Q12 is defective.

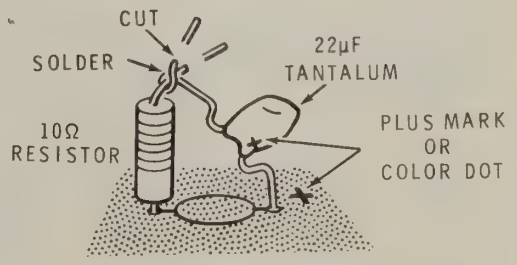
( ) Remove the defective transistor at Q12.

( ) Install a new 2N2369 transistor (#417-154) at Q12.

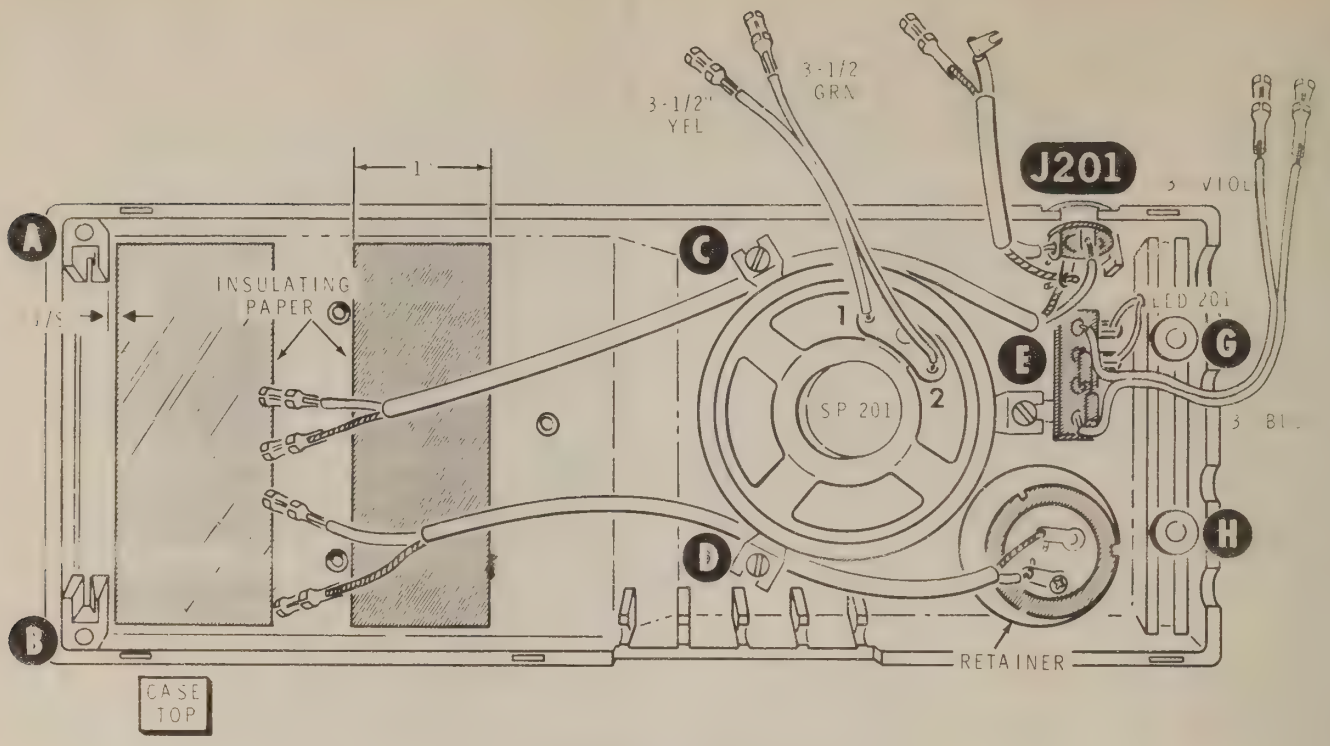
( ) Locate capacitor C39 on the main circuit board. Then heat the foil pad where the negative (unmarked) capacitor lead is installed only long enough so you can lift the lead up and away from the circuit board.

( ) Install a 10 Ω (brown-black-black) resistor in the hole where the negative lead of capacitor C39 was installed.

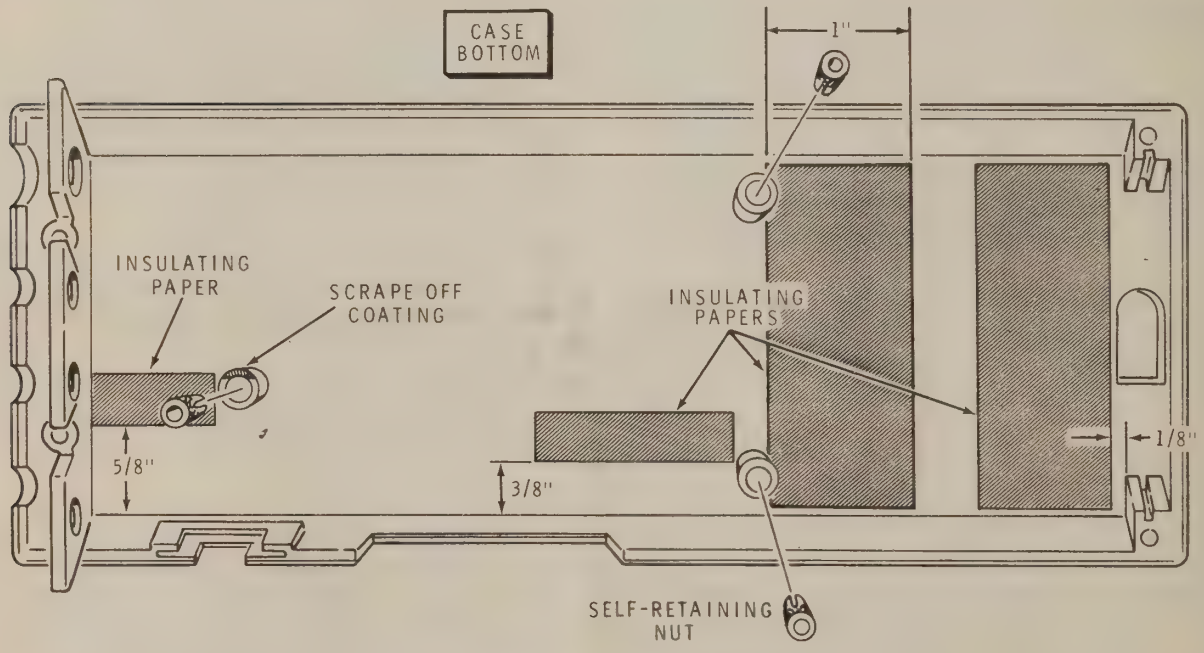
( ) Refer to Detail 2-1Y of these Instructions and solder the negative capacitor lead to the free resistor lead as shown.



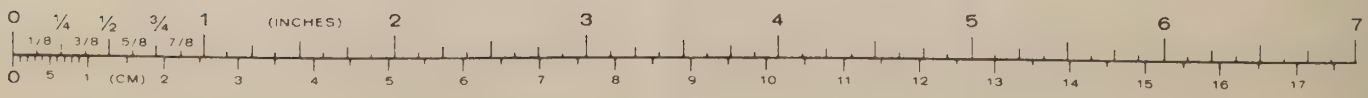

**Detail 2-1Y**




**PICTORIAL 3-1**




**PICTORIAL 4-1**
**(Repeat)**



# CASE ASSEMBLY

## VI.

When the springs in the battery housing are making contact with the conductive coating inside the case halves, the battery pack will be shorted, resulting in damage to the batteries. Perform the next steps if you have not already installed the prepared pieces of insulating paper in the case halves.

( ) Cut one of the 2-1/8″ × 3″ pieces of insulating paper into two pieces: one piece with the dimensions 1-1/8″ × 3″, and the other piece with the dimensions 1″ × 3″.

( ) Refer to the new Pictorial 3-1 and peel off the backing paper from each of the pieces of insulating paper. Then press each paper into place inside the case top at the locations shown.

( ) Similarly, cut the remaining 2-1/8″ × 3″ piece of insulating paper into two pieces with the dimensions given in the previous step.

( ) Refer to the new Pictorial 4-1 and peel off the backing paper from each of the pieces of insulating paper. Then press each paper into place inside the case bottom at the locations shown.

NOTE: Discard the 1/2″ × 3/8″ piece of insulating paper you are instructed to prepare on Page 54, left column, 5th step, of the Manual.

If you already have installed the prepared pieces of insulating paper in the case halves, as per the Assembly Manual, complete the following two steps.

( ) Cut off a 3″ length of 1/2″ wide electrical tape. Then press the tape in place on the inside of the case top where the springs of the battery housing could make contact with the conductive coating.

( ) Similarly, press a 3″ length of 1 /2″-wide electrical tape in the corresponding area inside the case bottom.

## VII.

If you cannot plug the connector on the end of the charging cable into the socket on the battery charger circuit board after the Transceiver has been assembled, perform the following three steps. NOTE: The battery charger circuit board **must** slide freely into the slots inside the case bottom.

( ) Remove the battery pack from the transceiver case bottom.

( ) Unplug the battery charger circuit board from the battery housing.

( ) Position the circuit board with the foil side up. Then remove any **excessive** solder buildup from around the red wire near the "+" terminal of the circuit board.

## VIII.

If you feel that too little pressure is required to operate the transceiver PTT switch, this can be improved if you complete the following steps.

( ) Cut two pieces of foam tape: one 1/4″ long and the other 3/8″ long.

( ) Peel the paper backing from one piece at a time and press each piece against the inside of the PTT switch actuator and opposite the ones on the PTT switch.

This completes the modification of your Transceiver.

~~Charleston Clinic~~
CHARLESTON, MISS. 38921

P.O. Box 338

PAUL R. GOOGE, M. D.
A. W. HULETT, M. D.

T. T. LEWIS, M. D.
C. W. TAINTOR, M. D.

7 Sept 76

Heath Company
Benton Harbor Michigan

attn Service Dept

Dear Sir:

There two 2 Meter transceivers HW2021 were purchased for you April 28, 1976 & construction began 1 May 76. Both have incorporated all the changes & modifications sent to me by your Technical Department in June 1976. Both have 2 additional crystals in them purchased thru Heath.

Set A:

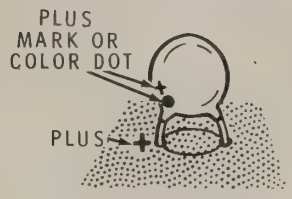
Completed & checked out OK thru page 50. Voltage checks on Transmitter aliniment on pag 51 & receiver aliniment page 52-53 were unsatisfactory & need your correction.

Set B

Completed except for final assembly on pag 54-57 Resistance checks OK as on page 44 Voltage checks on pg 45 & forward unsatisfactory. Parts for final assembly are in small plastic box. Please see which components or solder connection are incorrect, replace and/or repair and aline transmitter & receiver for use.

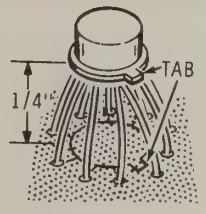
Many thanks

A. W. Hulett, M.D.



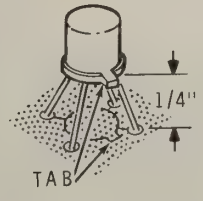

When you install tantalum capacitors, ALWAYS insert the plus (+) or color dot marked lead into the plus (+) marked hole in the circuit board.

**Detail 2-1M**




Refer to the illustration above and position the tab of the IC over the outline of the tab on the circuit board. Then insert the IC pins into the circuit holes. Make sure all of the IC pins go through the circuit board. Solder the pins to the foil. If a pin does not have foil around it, do not solder it.

**Detail 2-1N**

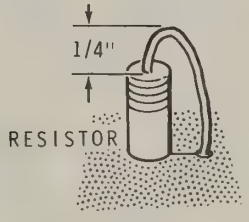



Position the tab over the outline of the tab on the circuit board. Then insert the leads into the circuit board. Solder the leads to the foil and cut off the excess lead lengths.

**Detail 2-1P**


Insert a cut-off resistor lead through the ferrite bead. Bend one resistor lead along the side of the ferrite bead. Then mount the ferrite bead over the circuit board outline and push it down against the circuit board as shown.

**Detail 2-1Q**

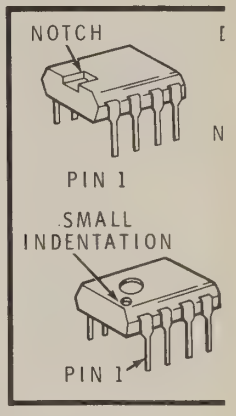


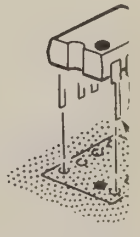

Bend a 1/4" loop in the upper resistor lead. Then bend the lead along the side of the resistor body. Mount the resistor over the circuit board outline and push it down against the circuit board as shown.

**Detail 2-1R**

Insert the lugs throu
and solder them to th

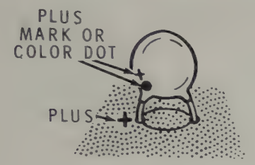
**Detail 2**



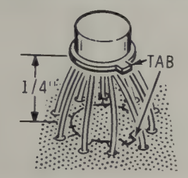
Refer to the illustrati
pin 1 of the IC. Then
pin 1 is inserted into
board. Make sure tha
through the circuit bo
to the foil. If a pin
around it, do not solde

**Detail 2**



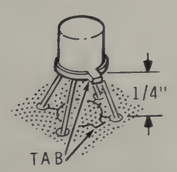

When you install tantalum capacitors, ALWAYS insert the plus (+) or color dot marked lead into the plus (+) marked hole in the circuit board.

**Detail 2-1M**




Refer to the illustration above and position the tab of the IC over the outline of the tab on the circuit board. Then insert the IC pins into the circuit holes. Make sure all of the IC pins go through the circuit board. Solder the pins to the foil. If a pin does not have foil around it, do not solder it.

**Detail 2-1N**




Position the tab over the outline of the tab on the circuit board. Then insert the leads into the circuit board. Solder the leads to the foil and cut off the excess lead lengths.

**Detail 2-1P**


Insert a cut-off resistor lead through the ferrite bead. Bend one resistor lead along the side of the ferrite bead. Then mount the ferrite bead over the circuit board outline and push it down against the circuit board as shown.

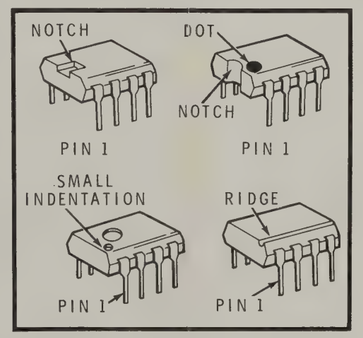
**Detail 2-1Q**


Bend a 1/4" loop in the upper resistor lead. Then bend the lead along the side of the resistor body. Mount the resistor over the circuit board outline and push it down against the circuit board as shown.

**Detail 2-1R**

Insert the lugs through the circuit board and solder them to the foil.

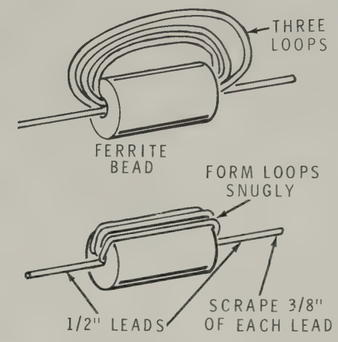
**Detail 2-1S**





Refer to the illustration above and locate pin 1 of the IC. Then install the IC so that pin 1 is inserted into hole 1 in the circuit board. Make sure that all of the pins go through the circuit board. Solder the pins to the foil. If a pin does not have foil around it, do not solder it.

**Detail 2-1T**

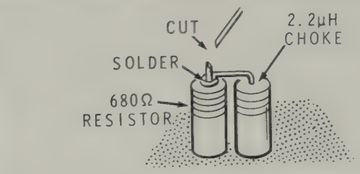



A. Cut a 3-1/2" length of magnet wire. Thread this wire through the ferrite bead so there are three complete loops through the bead. Form the loops down against the bead as neatly as possible. Be careful not to damage the wire coating.

B. Cut the leads to 1/2". Then scrape 3/8" of coating from the end of each lead. Use a knife blade. Discard the cut-off wire.

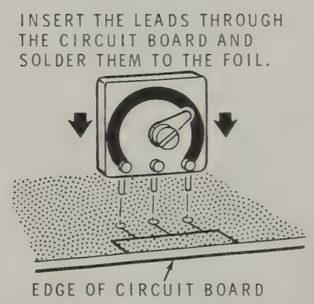
C. Insert the leads into the proper holes. Solder the leads to the foil and cut off the excess lead lengths.

**Detail 2-1U**




Mount the choke and the resistor vertically with the lead of the choke soldered to the lead of the resistor as shown.

**Detail 2-1V**



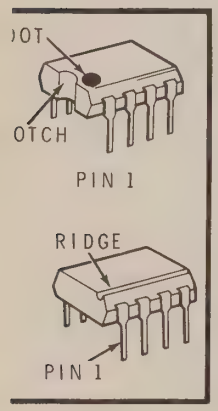

**Detail 2-1W**


Push the transistor into the heat sink. Then position the tab of the transistor over the outline of the tab on the circuit board. Insert the leads into the proper circuit board holes. Solder the leads to the foil and cut off the excess lead lengths.

**Detail 2-1X**

gh the circuit board
e foil.

2-1S





on above and locate
install the IC so that
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t all of the pins go
ard. Solder the pins
does not have foil
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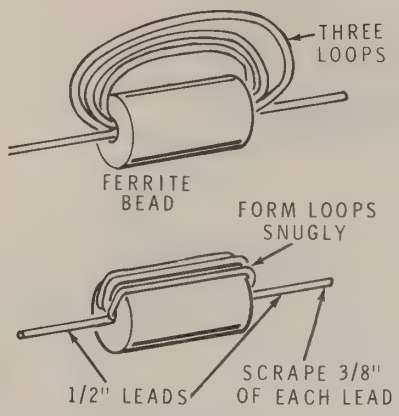
2-1T

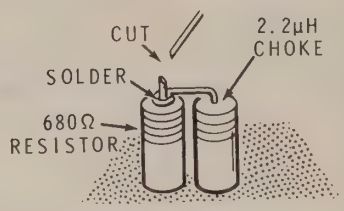



A. Cut a 3-1/2" length of magnet wire. Thread this wire through the ferrite bead so there are three complete loops through the bead. Form the loops down against the bead as neatly as possible. Be careful not to damage the wire coating.

B. Cut the leads to 1/2". Then scrape 3/8" of coating from the end of each lead. Use a knife blade. Discard the cut-off wire.

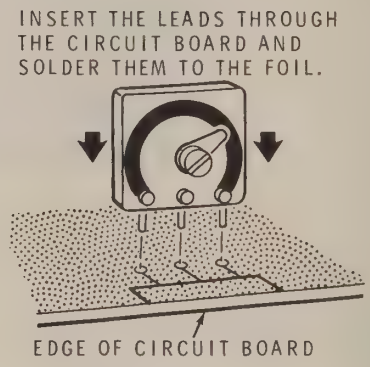
C. Insert the leads into the proper holes. Solder the leads to the foil and cut off the excess lead lengths.

**Detail 2-1U**

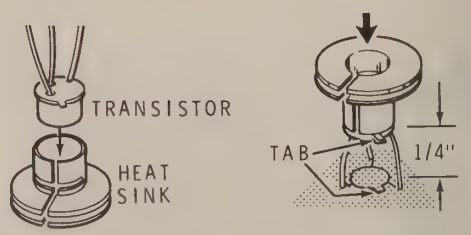



Mount the choke and the resistor vertically with the lead of the choke soldered to the lead of the resistor as shown.

**Detail 2-1V**

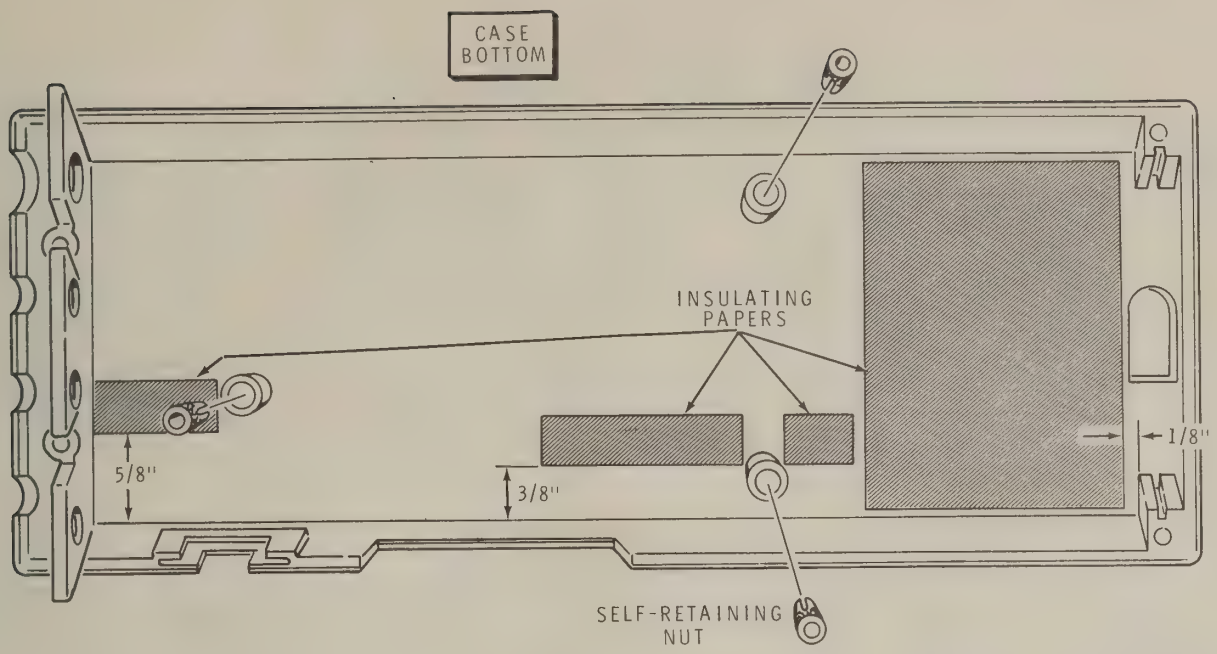



**Detail 2-1W**




Push the transistor into the heat sink. Then position the tab of the transistor over the outline of the tab on the circuit board. Insert the leads into the proper circuit board holes. Solder the leads to the foil and cut off the excess lead lengths.

**Detail 2-1X**




**PICTORIAL 4-1**

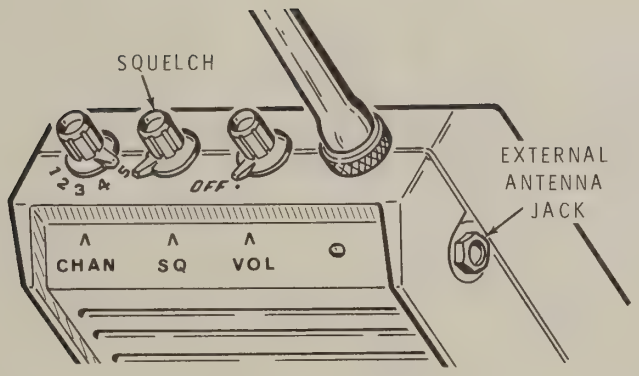
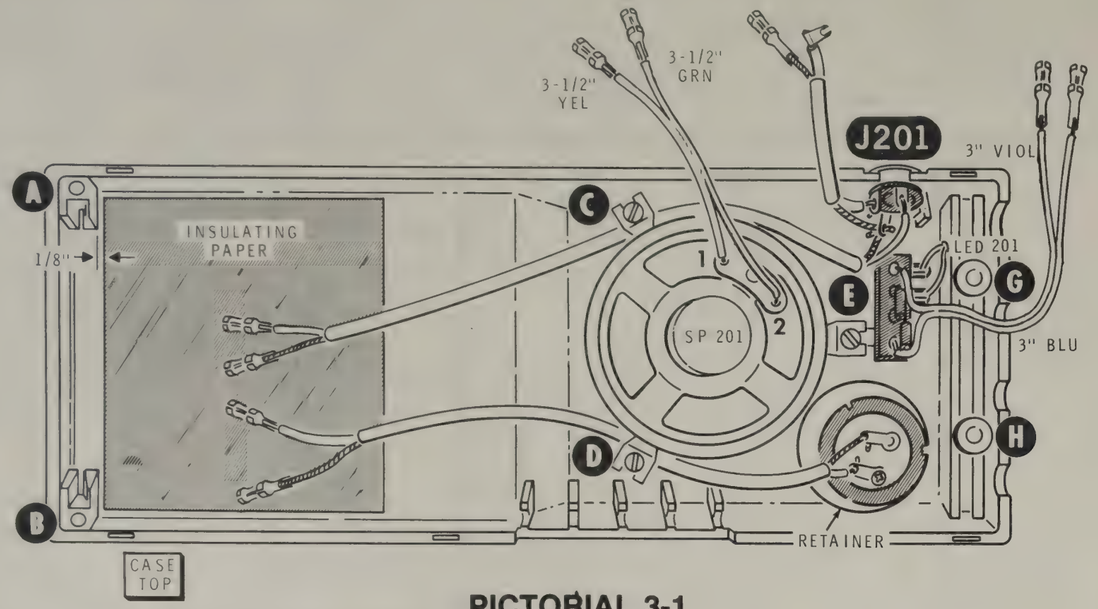
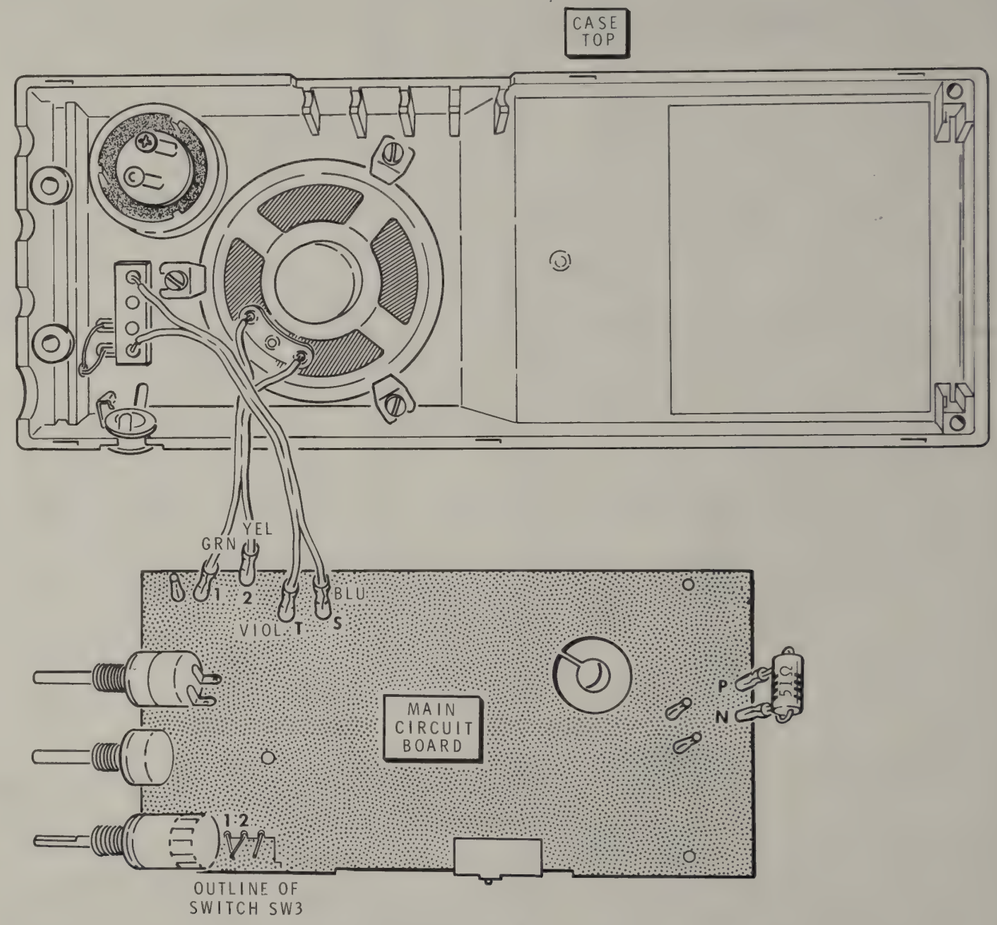



**Figure 6**

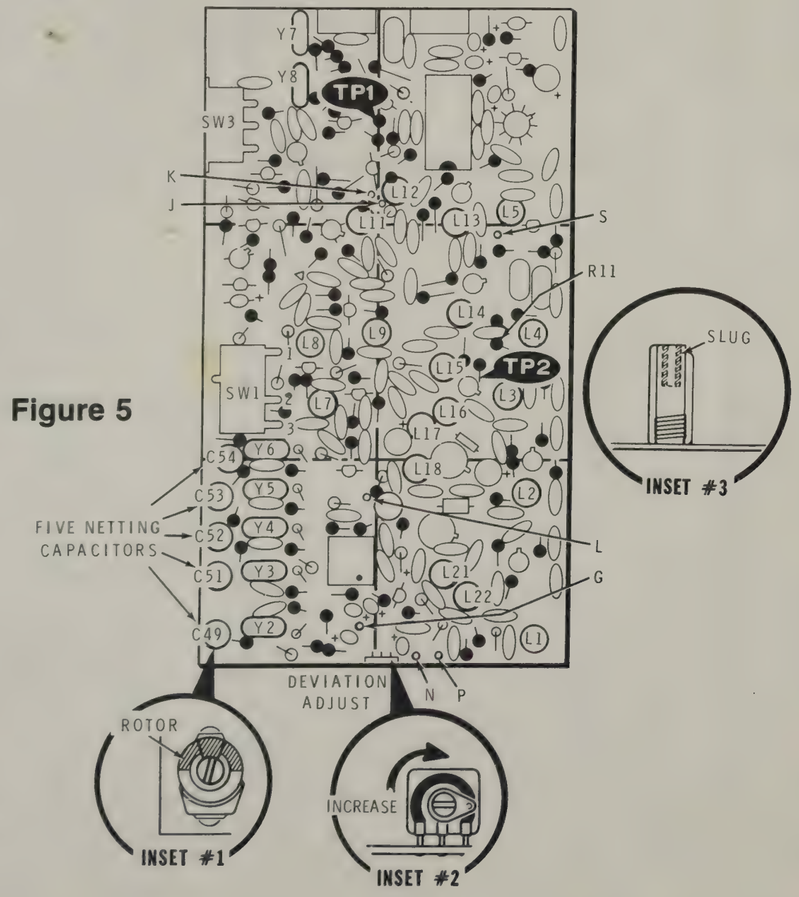


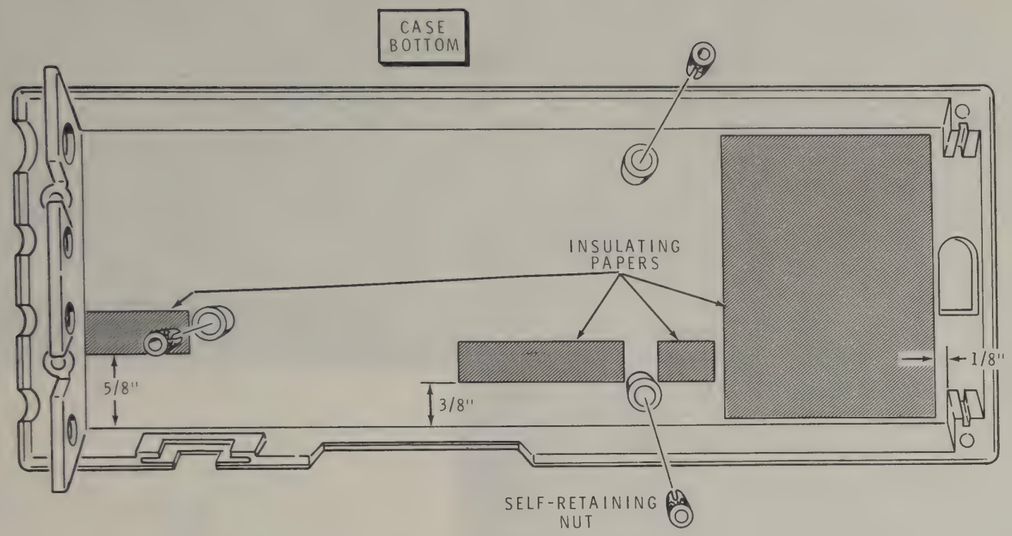

**PICTORIAL 3-1**




**PICTORIAL 3-2**

**Figure 5**






**PICTORIAL 4-1**

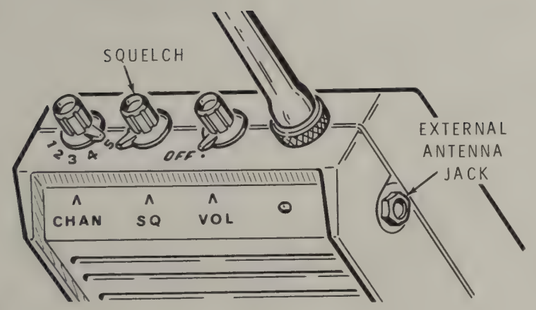
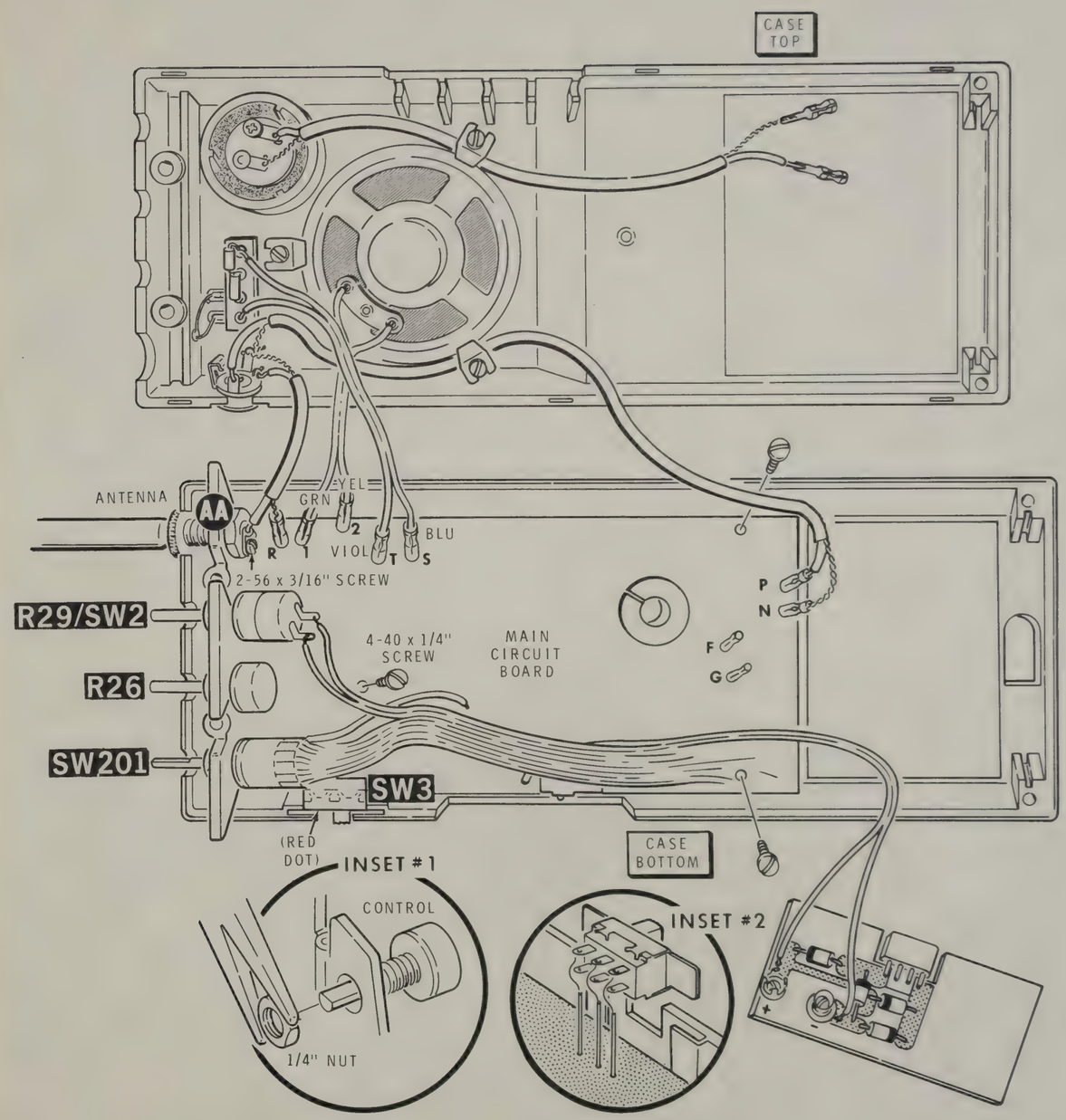
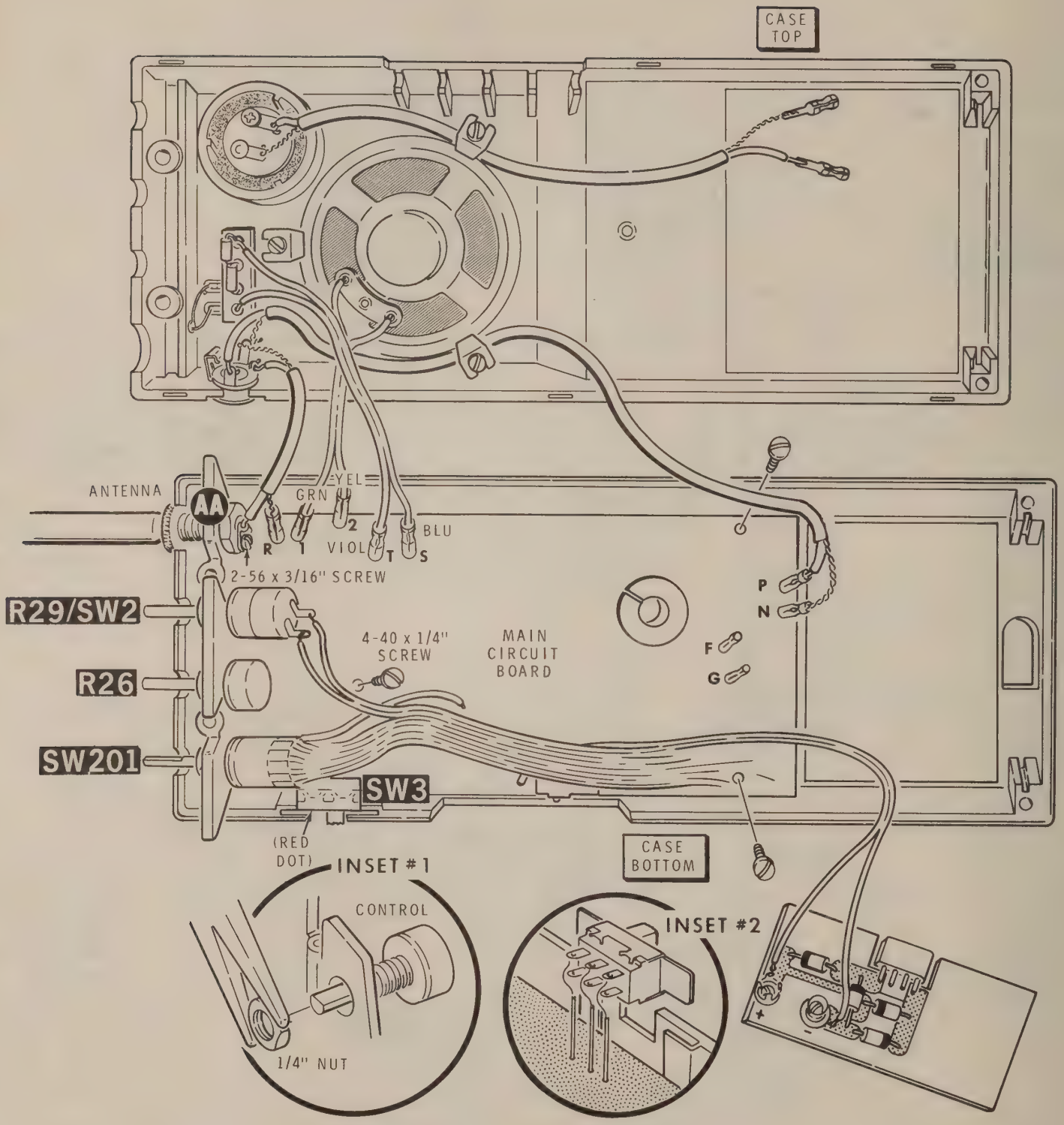



**Figure 6**

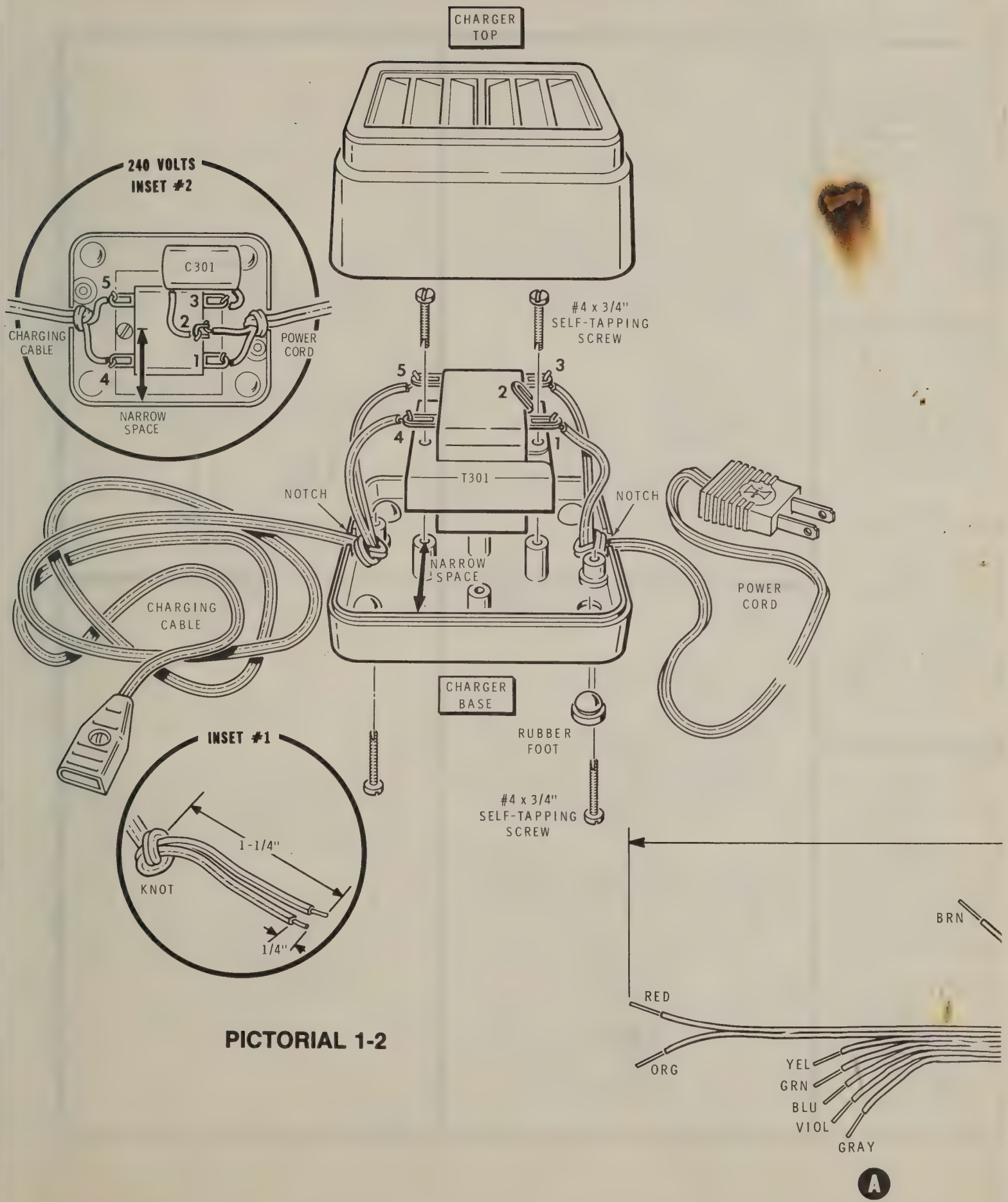



**PICTORIAL 4-2**



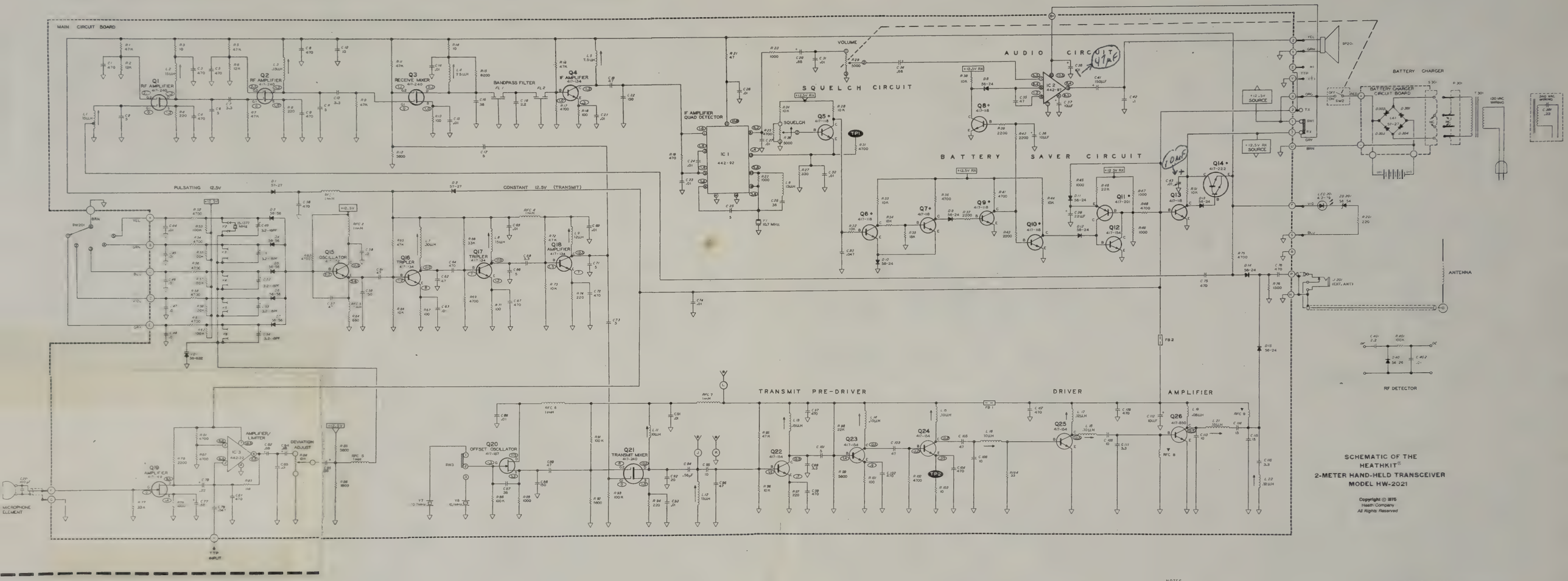

**PICTORIAL 4-2**

# ILLUSTRATION




**PICTORIAL 1-2**

A




SCHEMATIC OF THE
HEATHKIT®
2-METER HAND-HELD TRANSCEIVER
MODEL HW-2021



TABLE 1
SQUELCH CONTROL FULLY CLOCKWISE, NO INPUT SIGNAL

| | E | B | C |
|---|---|---|---|
| Q5 | 4 | 1.2 | 5.5 |
| Q6 | 6 | 1.2 | 8.0 |
| Q7 | .6 | 1.3 | 8.0 |
| Q8 | 0 | .7 | 1 |
| Q9 | 0 | .5 | 1.6 |
| Q10 | 0 | .7 | 1 |
| Q11 | - | 6.0 | - |

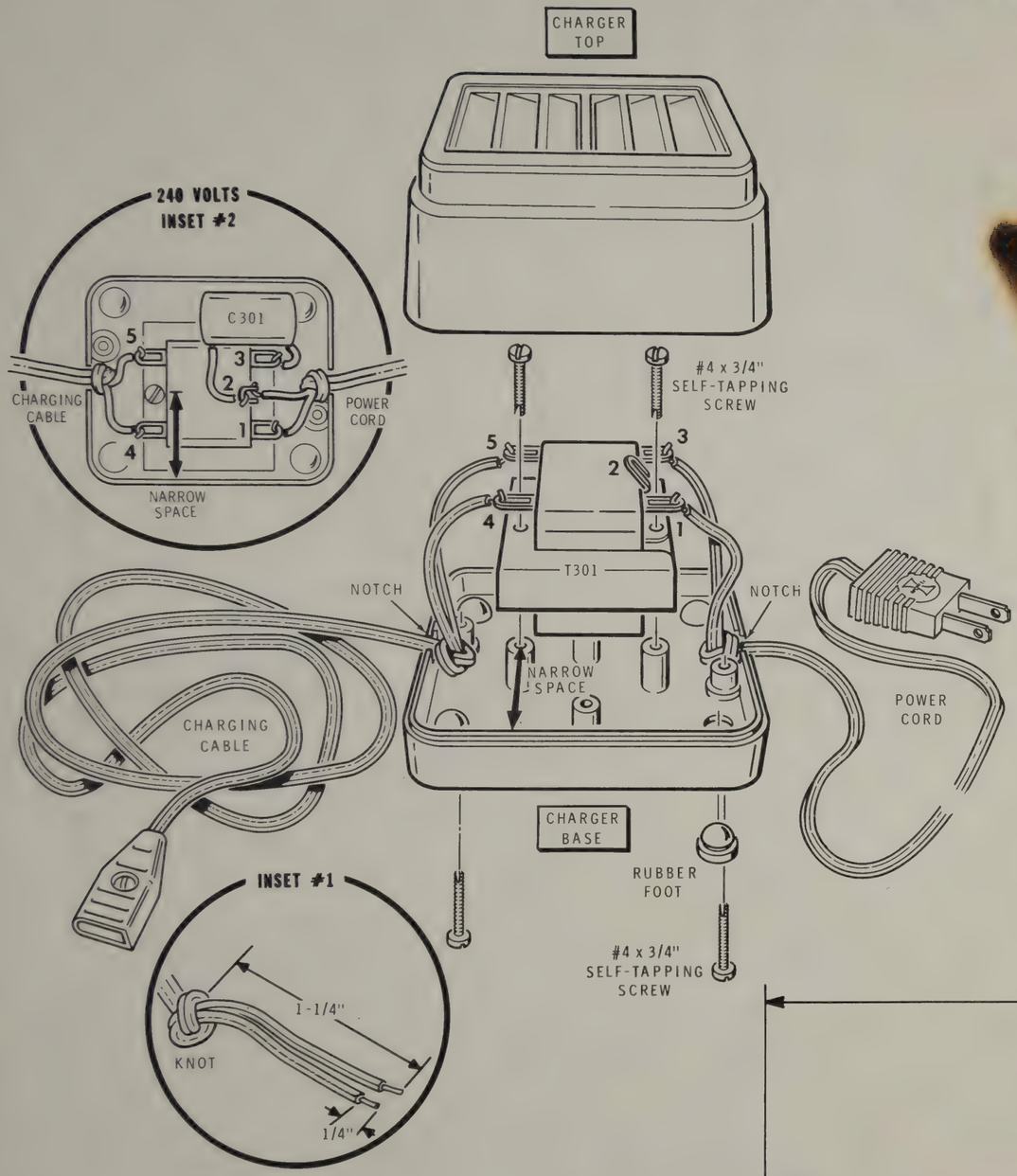
TABLE 2
SQUELCH CONTROL FULLY COUNTER CLOCKWISE, NO INPUT SIGNAL

| | E | B | C |
|---|---|---|---|
| Q5 | 5 | 0 | 7.0 |
| Q6 | 6 | 6 | 8 |
| Q7 | .6 | 1 | 5.0 |
| Q8 | 0 | .3 | 12.5 |
| Q9 | 0 | .7 | 1 |
| Q10 | 0 | .1 | 11.4 |
| Q14 | 12.5 | 12.5 | 11.8 |

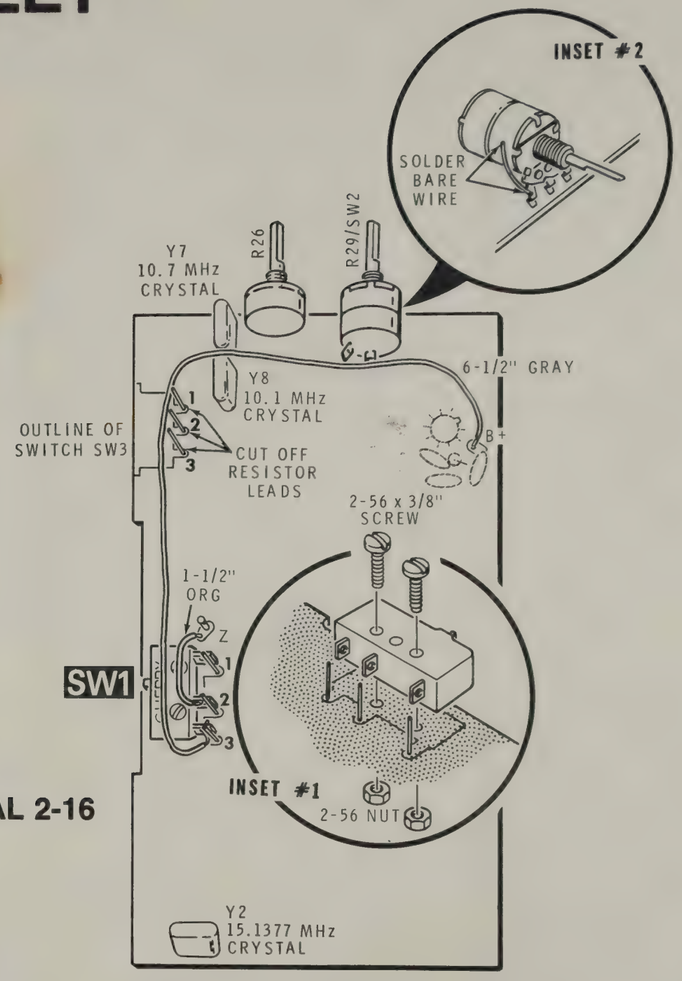
NOTES:

1. COMPONENT NUMBERS ARE IN THE FOLLOWING GROUPS:
   1-199 PARTS ON THE MAIN CIRCUIT BOARD.
   201-299 PARTS IN THE CASE.
   301-399 PARTS IN THE BATTERY CHARGER.
   401-499 PARTS ON THE RF DETECTOR.
2. ALL RESISTORS ARE 1/4-WATT, 5% TOLERANCE, UNLESS OTHERWISE NOTED. RESISTOR VALUES ARE IN OHMS: K=1000, M=1,000,000
3. CAPACITORS EQUAL TO OR LESS THAN .1 ARE IN μF (MICROFARADS). ALL OTHER CAPACITORS ARE IN pF (PICOFARADS) UNLESS OTHERWISE MARKED.
4. INDUCTORS ARE SHOWN IN MH (MILLIHENRIES) AND μH (MICROHENRIES).
5. ⬭ THIS SYMBOL INDICATES A DC VOLTAGE MEASUREMENT TAKEN WITH A HIGH INPUT IMPEDANCE VOLTMETER FROM THE POINT INDICATED TO CHASSIS GROUND UNDER THE FOLLOWING CONDITIONS:
   A. NO INPUT SIGNAL.
   B. SQUELCH CONTROL FULLY CLOCKWISE.
   C. VOLUME CONTROL FULLY COUNTERCLOCKWISE.
   D. LOWEST FREQUENCY OSCILLATOR CRYSTAL SELECTED.
   E. TRANSMITTER VOLTAGES- KEYED WITHOUT MODULATION.
6. ▽ THIS SYMBOL INDICATES CHASSIS GROUND.
   ○ THIS SYMBOL INDICATES A SOLDERED CONNECTION TO THE MAIN CIRCUIT BOARD.
   ◆ SEE TABLES 1 AND 2 FOR VOLTAGES.
   ▼ THIS SYMBOL DENOTES A CHOKE WOUND BY THE KIT BUILDER.
7. REFER TO THE "CIRCUIT BOARD X-RAY VIEWS" FOR THE PHYSICAL LOCATION OF PARTS.
8. TP INDICATES TEST POINT.
9. ✱ INDICATES TEST POINT USED ONLY WHEN ALIGNMENT IS PERFORMED WITHOUT INSTRUMENTS.

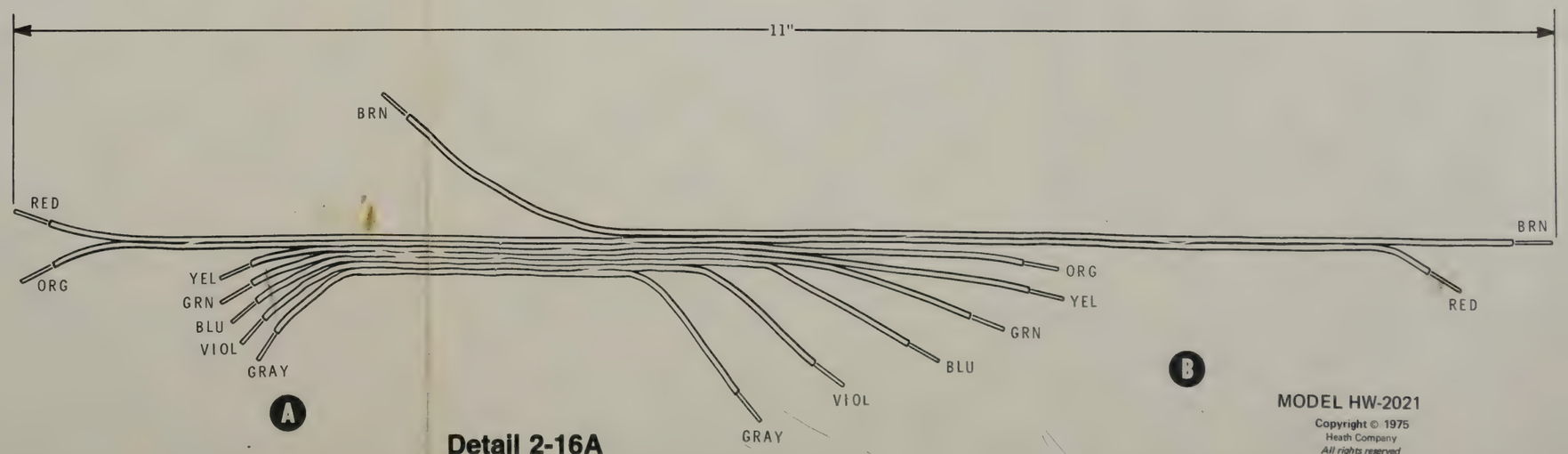
# ILLUSTRATION BOOKLET




**PICTORIAL 1-2**



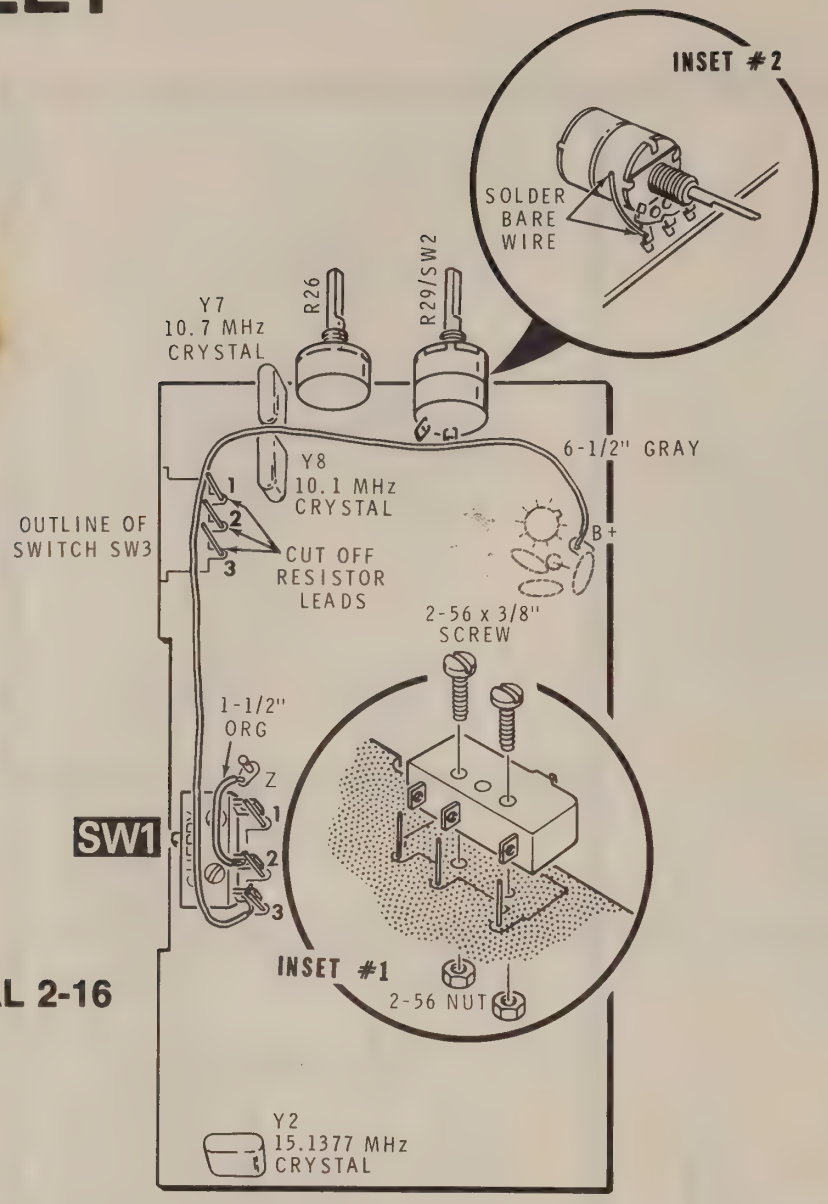

**PICTORIAL 2-16**



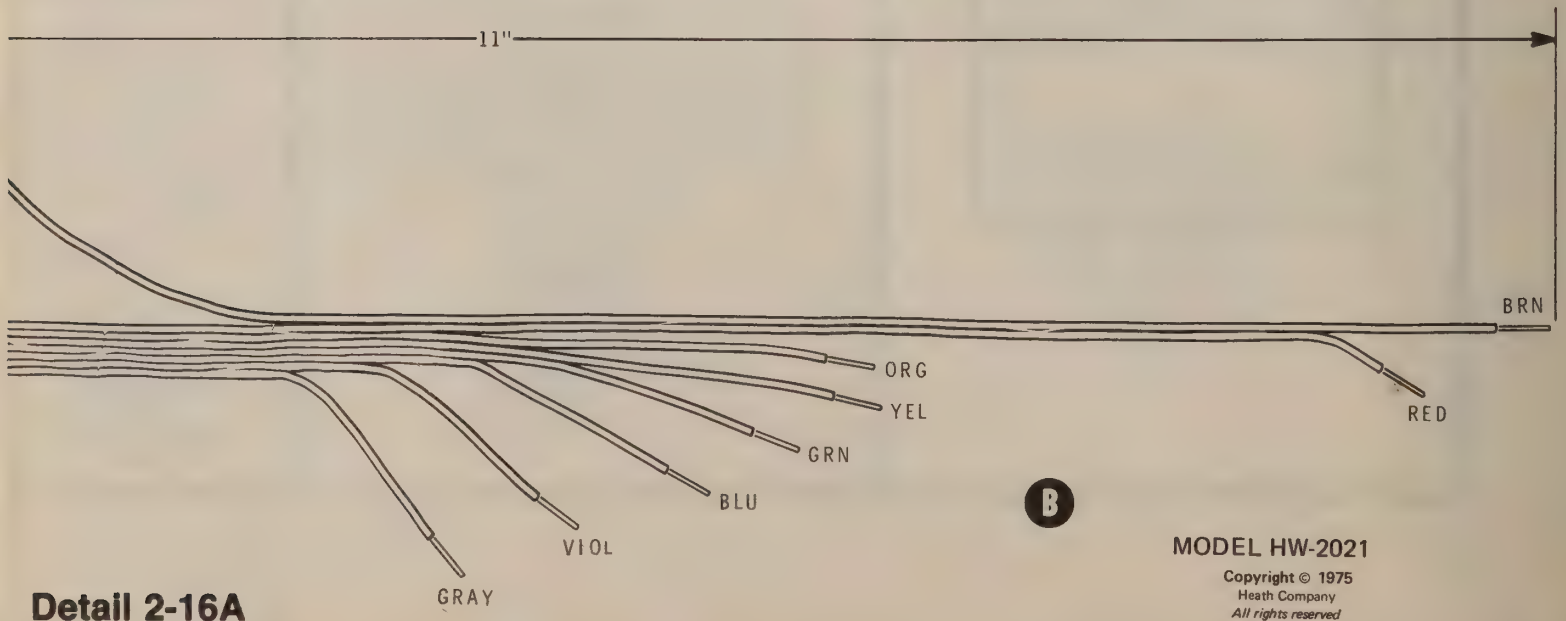

**Detail 2-16A**

MODEL HW-2021

# BOOKLET




**PICTORIAL 2-16**

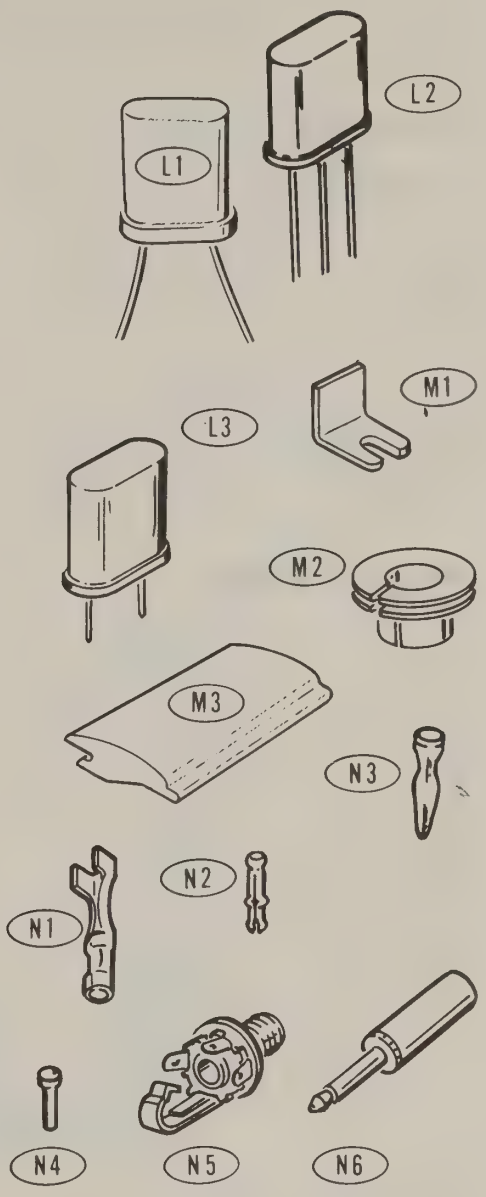



**Detail 2-16A**

B

MODEL HW-2021

| KEY No. | | QTY. | DESCRIPTION | PART No. | CIRCUIT Component No. |
|---|---|---|---|---|---|
| **CRYSTALS** | | | | | |
| L1 | ( ) | 1 | 10.7 MHz, long leads | 404-402 | Y1 |
| L2 | ( ) | 2 | 10.7 MHz crystal filter | 404-535 | FL1, FL2 |
| L3 | ( ) | 1 | 10.7 MHz | 404-562 | Y7 |
| L3 | ( ) | 1 | 10.1 MHz | 404-563 | Y8 |
| L3 | ( ) | 1 | 15.1377 MHz | 404-564 | Y2 |
| **CABLES-WIRE** | | | | | |
| | ( ) | 24" | Coaxial cable | 343-15 | |
| | ( ) | 18" | 8-wire cable | 347-55 | |
| | ( ) | 12" | Magnet wire (enameled) | 348-3 | |
| **METAL PARTS** | | | | | |
| M1 | ( ) | 3 | L-bracket | 204-1840 | |
| M2 | ( ) | 1 | Heat sink | 215-45 | |
| M3 | ( ) | 1 | PTT switch actuator | 266-859 | |
| **CONNECTORS** | | | | | |
| N1 | ( ) | 13 | PCB connector (1 extra) | 432-120 | |
| N2 | ( ) | 15 | Connector pin (2 extra) | 432-121 | |
| N3 | ( ) | 3 | Wire socket (1 extra) | 432-134 | |
| N4 | ( ) | 14 | Pin socket | 432-878 | |
| N5 | ( ) | 1 | Antenna jack | 436-16 | J201 |
| N6 | ( ) | 1 | Phone plug | 438-26 | |




## HARDWARE

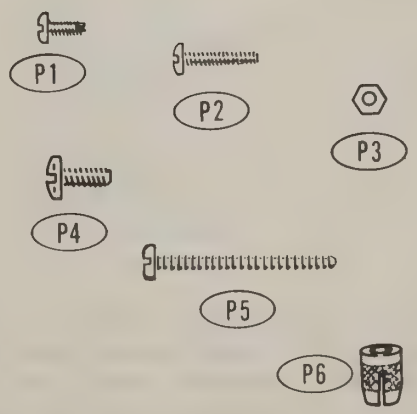
NOTE: The hardware may be in more than one packet. Open all the hardware packets in this pack before you check the hardware against the Parts List.

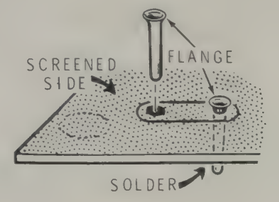
### #2 Hardware

| | | | | | |
|---|---|---|---|---|---|
| P1 | ( ) | 1 | 2-56 x 3/16" screw | 250-212 | |
| P2 | ( ) | 2 | 2-56 x 3/8" screw | 250-175 | |
| P3 | ( ) | 2 | 2-56 nut | 252-51 | |

### #4 Hardware

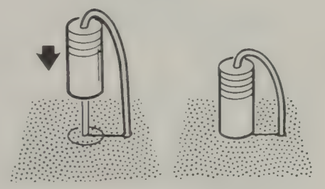
| | | | | | |
|---|---|---|---|---|---|
| P4 | ( ) | 6 | 4-40 x 1/4" screw | 250-52 | |
| P5 | ( ) | 4 | 4-40 x 15/16" screw | 250-480 | |
| P6 | ( ) | 10 | 4-40 self-retaining nut | 252-192 | |






Push the pin socket through the circuit board hole from the screened side. Then solder the socket to the other side of the circuit board.

**Detail 2-1A**



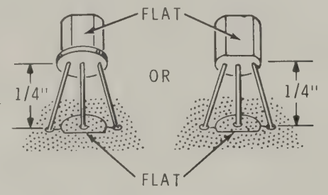
Bend one resistor lead along the side of the resistor body. Then mount the resistor over the circuit board outline and push it down against the circuit board as shown.

**Detail 2-1B**


Install a diode in this manner: Hold the diode lead with pliers so you do not break the glass body.

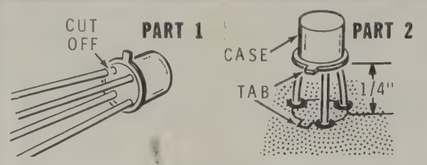
Bend one diode lead along the side of the diode body. Then mount the diode over the circuit board outline and push it down against the circuit board as shown. NOTE: Be sure to position the banded end of each diode up.

**Detail 2-1C**




Position the flat of the transistor over the outline of the flat on the circuit board. Then insert the leads into the proper circuit board holes. Solder the leads to the foil and cut off the excess lead lengths.

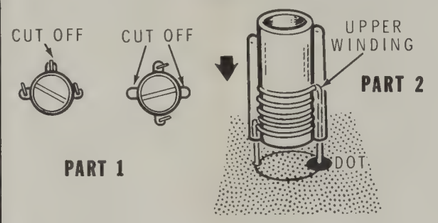
**Detail 2-1D**




1. Cut off the indicated lead.
2. Position the tab of the transistor over the outline of the tab on the circuit board. Then insert the leads into the proper circuit board holes. Solder the leads to the foil and cut off the excess lead lengths.

NOTE: Make sure the transistor case does not touch adjacent component leads.

**Detail 2-1E**

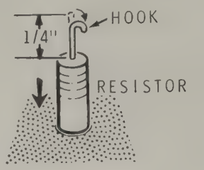



1. Cut off the indicated tab(s) on all the coils.
2. Locate the coil lead that comes from the upper winding of the coil. Insert this lead into the hole marked by a dot. Solder the coil leads to the foil and cut off the excess lead lengths.

**Detail 2-1F**

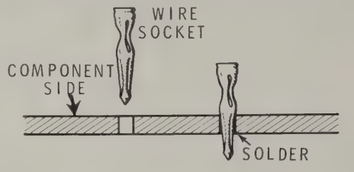
Bend one coil lead along the side of the coil body (toward the slot, if any, in the coil form.) Then mount the coil over the circuit board outline and push it down against the circuit board as shown.

**Detail 2-1G**



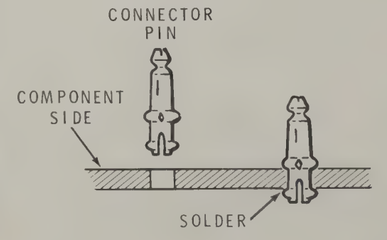

Mount the resistor over the circuit board outline and push it down against the circuit board as shown. Then cut the other lead to 1/4" and bend it into a hook.

**Detail 2-1H**



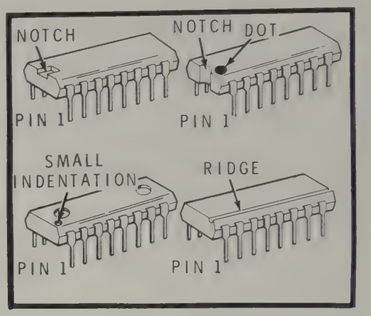

Solder each wire socket to the foil as you install it. NOTE: Use a minimum amount of solder but make sure you have a good connection.

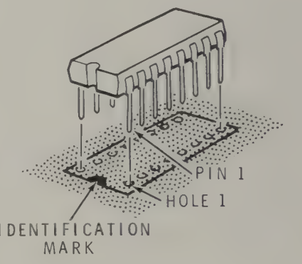
**Detail 2-1J**




Solder each pin to the foil as it is installed.

**Detail 2-1K**

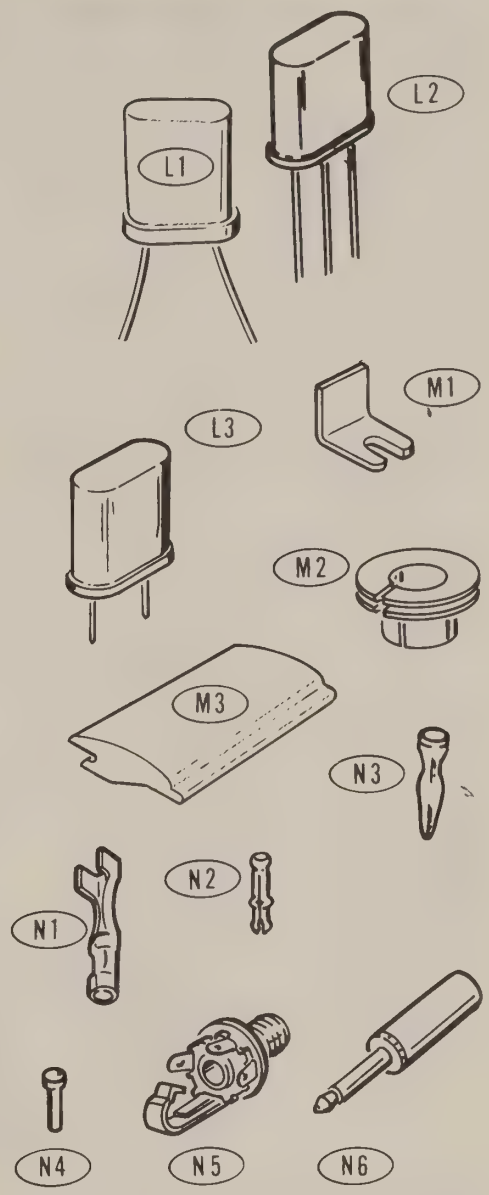



Refer to the illustration above and locate pin 1 of the IC. Then install the IC so that pin 1 is inserted into hole 1 on the circuit board. Make sure all of the IC pins go through the circuit board. Solder the pins to the foil. If a pin does not have foil around it, do not solder it.

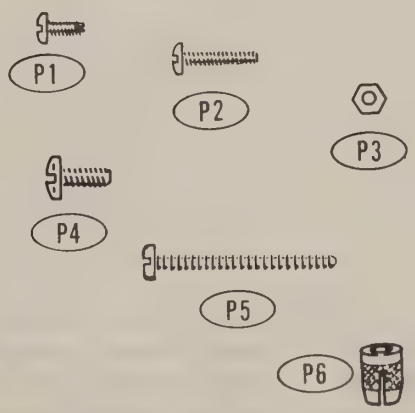
**Detail 2-1L**

| KEY No. | | QTY. | DESCRIPTION | PART No. | CIRCUIT Component No. |
|---|---|---|---|---|---|
| **CRYSTALS** | | | | | |
| L1 | ( ) | 1 | 10.7 MHz, long leads | 404-402 | Y1 |
| L2 | ( ) | 2 | 10.7 MHz crystal filter | 404-535 | FL1, FL2 |
| L3 | ( ) | 1 | 10.7 MHz | 404-562 | Y7 |
| L3 | ( ) | 1 | 10.1 MHz | 404-563 | Y8 |
| L3 | ( ) | 1 | 15.1377 MHz | 404-564 | Y2 |
| **CABLES-WIRE** | | | | | |
| | ( ) | 24" | Coaxial cable | 343-15 | |
| | ( ) | 18" | 8-wire cable | 347-55 | |
| | ( ) | 12" | Magnet wire (enameled) | 348-3 | |
| **METAL PARTS** | | | | | |
| M1 | ( ) | 3 | L-bracket | 204-1840 | |
| M2 | ( ) | 1 | Heat sink | 215-45 | |
| M3 | ( ) | 1 | PTT switch actuator | 266-859 | |
| **CONNECTORS** | | | | | |
| N1 | ( ) | 13 | PCB connector (1 extra) | 432-120 | |
| N2 | ( ) | 15 | Connector pin (2 extra) | 432-121 | |
| N3 | ( ) | 3 | Wire socket (1 extra) | 432-134 | |
| N4 | ( ) | 14 | Pin socket | 432-878 | |
| N5 | ( ) | 1 | Antenna jack | 436-16 | J201 |
| N6 | ( ) | 1 | Phone plug | 438-26 | |




## HARDWARE

NOTE: The hardware may be in more than one packet. Open all the hardware packets in this pack before you check the hardware against the Parts List.




### #2 Hardware

| | | | | | |
|---|---|---|---|---|---|
| P1 | ( ) | 1 | 2-56 x 3/16" screw | 250-212 | |
| P2 | ( ) | 2 | 2-56 x 3/8" screw | 250-175 | |
| P3 | ( ) | 2 | 2-56 nut | 252-51 | |

### #4 Hardware

| | | | | | |
|---|---|---|---|---|---|
| P4 | ( ) | 6 | 4-40 x 1/4" screw | 250-52 | |
| P5 | ( ) | 4 | 4-40 x 15/16" screw | 250-480 | |
| P6 | ( ) | 10 | 4-40 self-retaining nut | 252-192 | |

| KEY No. | QTY. | DESCRIPTION | PART No. | CIRCUIT Component No. |
|---|---|---|---|---|

## HARDWARE (cont'd.)

### 1/4" Hardware

| | | | |
|---|---|---|---|
| P7 | 4 | 1/4" nut | 252-39 |
| P8 | 1 | 1/4" flat washer | 253-170 |

### Other Hardware

| | | | |
|---|---|---|---|
| P9 | 1 | Control nut, hex | 252-76 |
| P10 | 1 | Control nut, round | 252-86 |
| P11 | 1 | #10 solder lug | 259-5 |

## MISCELLANEOUS

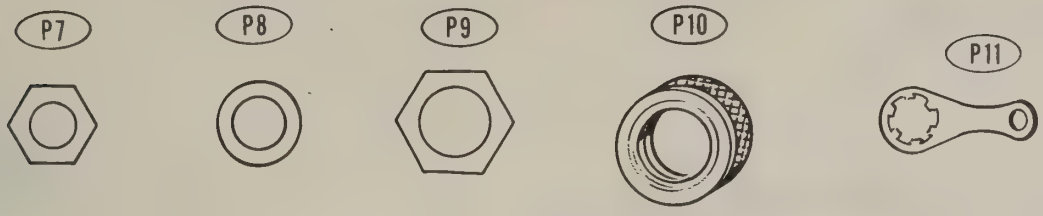
| | | | |
|---|---|---|---|
| | 12" | Foam tape | 73-39 |
| | 1 | Main circuit board | 85-1776-1 |
| Q1 | 1 | Case top | 92-614 |
| Q2 | 1 | Case bottom | 92-613 |
| Q3 | 1 | Antenna | 142-724 |
| | 1 | Speaker | 401-176 |
| Q4 | 1 | Terminal strip | 431-49 |
| Q5 | 1 | Bushing | 455-636 |
| Q6 | 3 | Knob | 462-952 |
| Q7 | 4 | Ferrite bead | 475-10 |
| Q8 | 1 | Microphone element | 480-69 |
| Q9 | 1 | Alignment tool | 490-109 |
| | 1 | Shadow mask | 490-184 |
| | 1 | Soder-Wick* | 490-185 |
| | | Solder (Additional 4-1/2' rolls of solder, #331-6, can be ordered for 40 cents each.) | |

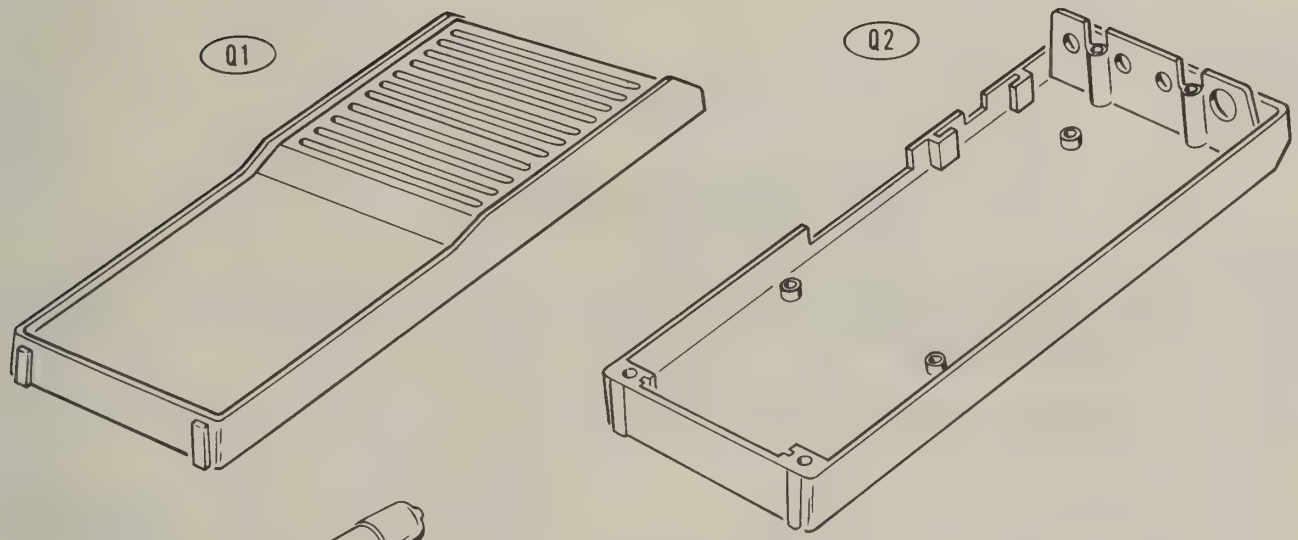
## PRINTED MATERIAL

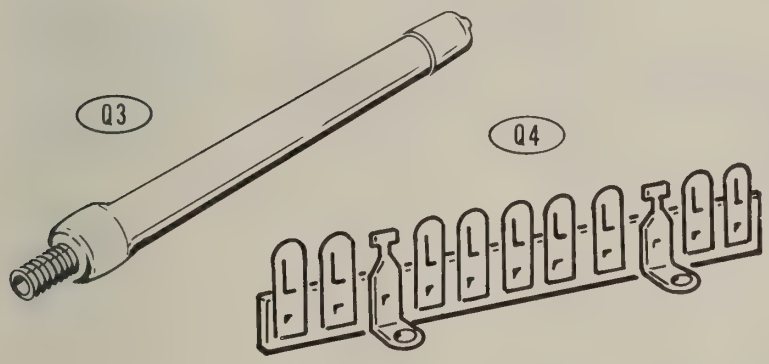
| | | | |
|---|---|---|---|
| Q10 | 1 | Function label | 390-1165 |
| Q11 | 1 | Decorative label | 390-1166 |
| Q12 | 1 | Blue and white label | 391-34 |
| | 1 | Parts Order Form | 597-260 |
| | 1 | Kit Builders Guide | 597-308 |
| | 1 | Assembly Manual (See front cover for part number.) | |

NOTE: The prices shown on the separate "Heath Parts Price List" apply only on purchases from Heath Company where shipment is to a U.S.A. destination. Add 10 percent (minimum 25 cents) to the price when ordering (Michigan residents add 4 percent sales tax) to cover insurance, postage, and handling. Outside the U.S.A., parts and service are available from your local Heathkit source and will reflect additional transportation,

*Registered Trademark, Solder Removal Co.

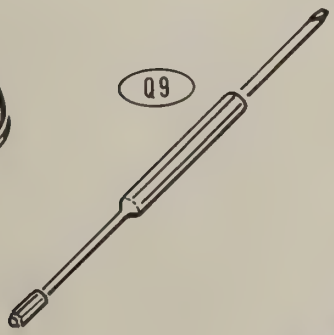

P7
P8
P9
P10
P11

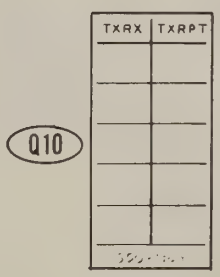

Q1
Q2

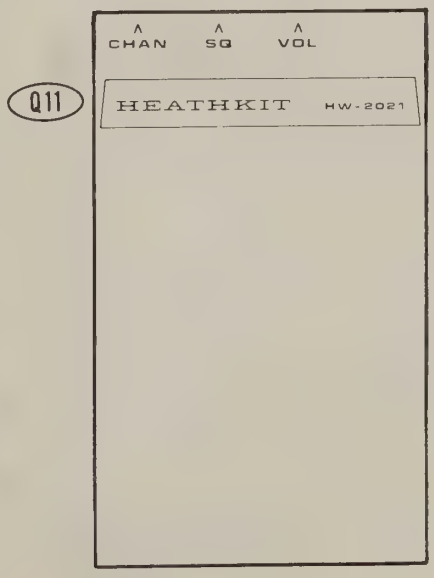

Q3
Q4

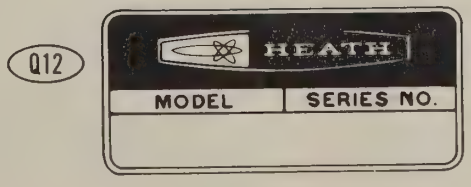

Q5
Q6
Q7


Q8


Q9


Q10
TXRX
TXRPT


Q11
CHAN
SQ
VOL
HEATHKIT
HW-2021


Q12
HEATH
MODEL
SERIES NO.

# BATTERY CHARGER

## ASSEMBLY NOTES

1. Before you start to assemble the battery charger, read the wiring, soldering, and step-by-step assembly information in the "Kit Builders Guide."

2. Follow the instructions carefully, and read the entire step before you perform each operation.

3. Position all parts as shown in the illustrations.

4. The illustrations in this Manual are called Pictorials and Details. Pictorials show the overall operation for a group of assembly steps; Details generally show a single step. When you are directed to refer to a certain Pictorial "for the following steps," continue using that Pictorial until you are referred to another Pictorial for another group of steps.

5. A separate "Illustration Booklet" contains illustrations (Pictorials, Details, etc.) that are too large for the Assembly Manual. The Step-by-Step Assembly instructions will direct you to the proper illustration in the Booklet. The illustrations are arranged in Pictorial number sequence. Place the Booklet in a convenient location and keep it with the Assembly Manual.

# STEP-BY-STEP ASSEMBLY

## CIRCUIT BOARD

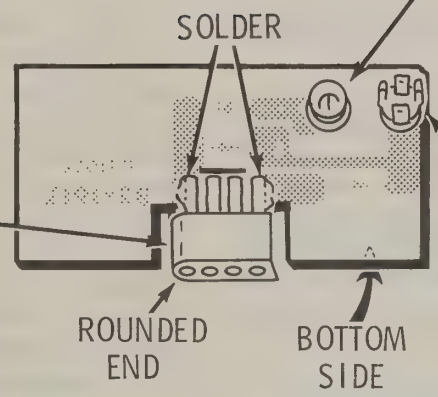
**START**

FOR GOOD SOLDER CONNECTIONS, YOU MUST **KEEP THE SOLDERING IRON TIP CLEAN.** WIPE IT OFTEN WITH A DAMP SPONGE OR CLOTH.

Position the battery charger circuit board, foil-side-up, as shown in the Pictorial. Then complete the following steps.

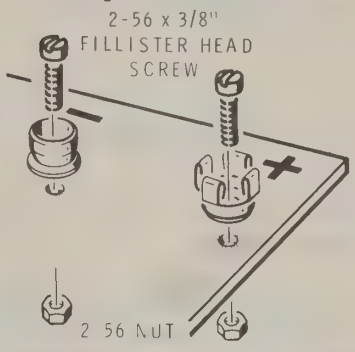
( ) S301: Push a 4-pin socket all the way into the notch of the circuit board with the rounded end as shown. Make sure the bottom side of the socket is flush with the bottom side of the circuit board. Then solder each of the two outer socket pins to the foil.

**FOIL SIDE**




**CONTINUE**

( ) Mount a male battery connector to the circuit board at the hole marked "–." Use a 2-56 x 3/8" fillister head screw and a 2-56 nut. DO NOT overtighten the screw.




( ) Similarly, mount a female battery connector at the hole marked "+."

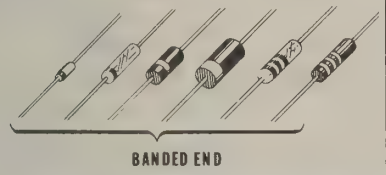
( ) Turn the circuit board over. Cut both screw ends off flush with the nuts. Then solder the nut to the screw at each location.

---

**START**

Position the circuit board foil-side-up as shown in the Pictorial. Then complete the following steps.

NOTE: DIODES MAY BE SUPPLIED IN ANY OF THE FOLLOWING SHAPES. ALWAYS POSITION THE BANDED END AS SHOWN ON THE CIRCUIT BOARD.




IMPORTANT: Where diodes are installed in the following steps, make sure each diode is down against the circuit board before you solder the leads to the foil.

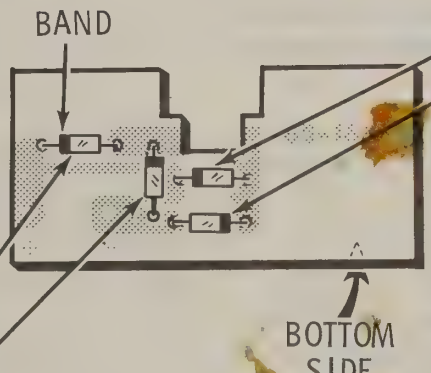
( ) D303: 1N2071 diode (#57-27).

( ) D304: 1N2071 diode (#57-27).

SAFETY WARNING: Avoid eye injury when you cut off excess lead lengths. Hold the leads so they cannot fly toward your eyes.

( ) Solder the leads to the foil and cut off the excess lead lengths from the bottom side of the circuit board.

**FOIL SIDE**




**PICTORIAL 1-1**

**CONTINUE**

( ) D302: 1N2071 diode (#57-27).

( ) D301: 1N2071 diode (#57-27).

( ) Solder the leads to the foil and cut off the excess lead lengths.

### CIRCUIT BOARD CHECKOUT

Carefully inspect the circuit board for the following conditions. NOTE: There are two unused holes.

( ) Unsoldered connections.

( ) "Cold" solder connections.

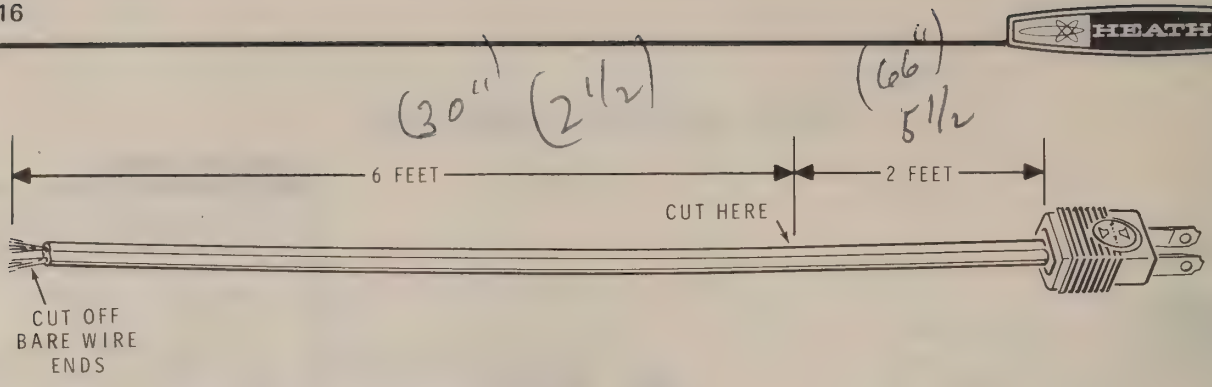
( ) Solder bridges between foil patterns.

( ) Protruding leads. No leads should be longer than 1/16".

( ) Diodes for the correct position of the banded end.

Temporarily set the circuit board aside.

**FINISH**




Detail 1-2A

## CHARGER ASSEMBLY

Refer to Pictorial 1-2 (in the "Illustration Booklet") for the following steps.

( ) Install a rubber foot in each of the four large holes in the charger base.

NOTE: The mounting posts on the charger base are off center. (One is closer to one side of the base than the other.) In the next step be sure you position the charger base so the narrower space, indicated by the bold arrow, is positioned as shown.

( ) T301: Bend transformer lug #2 straight up as shown. Then mount the transformer on the charger base. Use two #4 x 3/4" self-tapping screws.

( ) Refer to Detail 1-2A and straighten out the power cord. Then cut off the bare wires at the end of the cord.

NOTE: The following step instructs you to cut the power cord to specific lengths. However, you may want to adjust these lengths if you want a different length between the battery charger and the line cord plug.

( ) Cut the power cord 2' from the plug end. Then set the 2' long power cord and plug aside until it is called for in a step.

Refer to Detail 1-2B for the next six steps.

( ) 1. Separate the leads at one end of the 6-foot charging cable for about 1" and remove 1/8" of insulation from both leads.

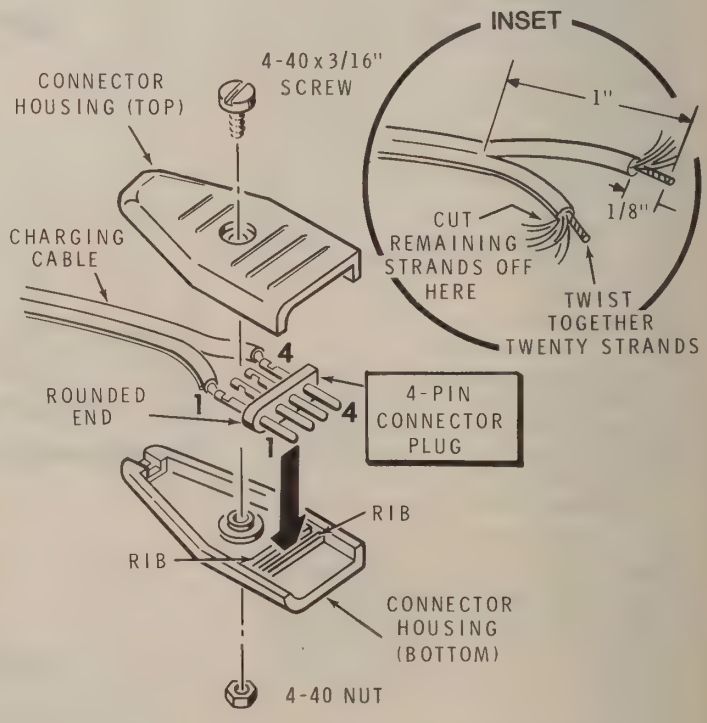
( ) 2. Refer to the inset drawing and cut off all but twenty wire strands from the end of each lead.

( ) 3. Twist together the strands and melt a very small amount of solder on the wire ends to hold the strands together.

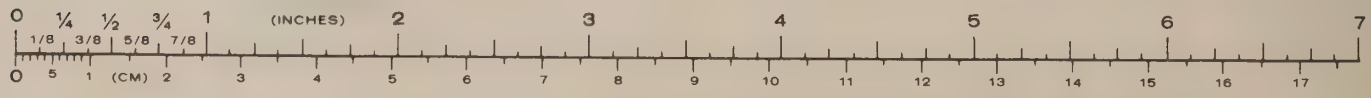
( ) 4. Position the 4-pin connector plug as shown. Note that pin 1 is at the rounded end of the plug.

NOTE: In the following steps, (NS) means not to solder because other wires will be added later. "S-" with a number, such as (S-3), means to solder the connection. The number following the "S" tells how many wires are at the connection.

( ) 5. Connect one prepared lead of the cable to 4-pin plug pin 1 (S-1) and the other lead to pin 4 (S-1).




Detail 1-2B



NOTE: The top and bottom halves of the connector housing have rounded sides that correspond to the rounded end of the 4-pin connector plug. When you perform the next step, be sure you position the rounded side of each connector housing toward the rounded end of the 4-pin plug. Also be sure you position the plug between the ribs in the connector housing.

( ) 6. Secure the top and bottom halves of the connector housing on the 4-pin connector plug with a 4-40 x 3/16" screw and a 4-40 nut.

( ) Refer to inset drawing #1 on Pictorial 1-2 and separate the leads at the free end of the 6-foot charging cable for a length of 1-1/2".

( ) Remove 1/4" of insulation from the ends of the charging cable leads. Twist together the fine strands and melt a small amount of solder on the wire ends to hold the strands together.

( ) Tie a knot at this end of the charging cable 1-1/4" from the end of the cable.

NOTE: In the following steps you will be instructed to make the connections mechanically secure before you solder them. To do this, first form a small hook at the end of the lead. Then hook the lead through the lug and crimp it securely to the lug with a pair of pliers.

( ) Connect one charging cable lead to transformer T301 lug 4 (S-1). Make this connection mechanically secure.

( ) Connect the other charging cable lead to transformer T301 lug 5 (S-1). Make this connection mechanically secure.

## ALTERNATE LINE VOLTAGE WIRING

Two sets of line voltage wiring instructions are given, one for 120 VAC line voltage and the other for 240 VAC line voltage. In the U.S.A., 120 VAC is most often used, while in foreign countries 240 VAC is more common. USE ONLY THE INSTRUCTIONS THAT AGREE WITH THE LINE VOLTAGE IN YOUR AREA.

### 120 VAC Wiring

( ) Refer to inset drawing #1 on Pictorial 1-2 and separate the leads at the free end of the 2-foot power cord for a length of 1-1/2".

( ) Remove 1/4" of insulation from the ends of the power cord leads. Twist together the fine strands and melt a small amount of solder on the wire ends to hold the strands together.

( ) Tie a knot at this end of the power cord 1-1/4" from the end of the cord.

( ) Connect one power cord lead to transformer T301 lug 1 (S-1). Make this connection mechanically secure.

( ) Connect the other power cord lead to transformer T301 lug 3 (S-1). Make this connection mechanically secure.

NOTE: You will have a .22 $\mu$F capacitor left over. It is only used for 240 VAC wiring. Proceed to Page 18.

### 240 VAC Wiring

( ) Refer to inset drawing #2 on Pictorial 1-2 and separate the leads at the free end of the 2-foot power cord for a length of 2-1/4".

( ) Remove and save a 1" length of insulation from each lead at this end of the power cord.

( ) Cut off a 3/4" length of the exposed wire ends from each lead. Twist together the remaining 1/4" long strands and melt a small amount of solder on the wire ends to hold the strands together.

( ) Tie a knot at this end of the power cord 1-1/4" from the end of the cord.

( ) Connect one power cord lead to transformer T301 lug 1 (S-1). Make this connection mechanically secure.

( ) Connect the other power cord lead to transformer T301 lug 2 (NS). Make this connection mechanically secure.

( ) Cut one lead of a .22 $\mu$F Mylar capacitor to a length of 1-1/8" and cut the other lead to 3/4".

( ) Place a 1" length of insulation (previously removed from the 2-foot power cord) on the longer capacitor lead.

( ) Position the capacitor as shown and connect the longer lead to transformer T301 lug 2 (S-2). Make this connection mechanically secure.

( ) Cut the remaining 1" length of insulation in half. Then place a 1/2" length on the shorter capacitor lead.

( ) Connect this lead to transformer T301 lug 3 (S-1). Make this connection mechanically secure.

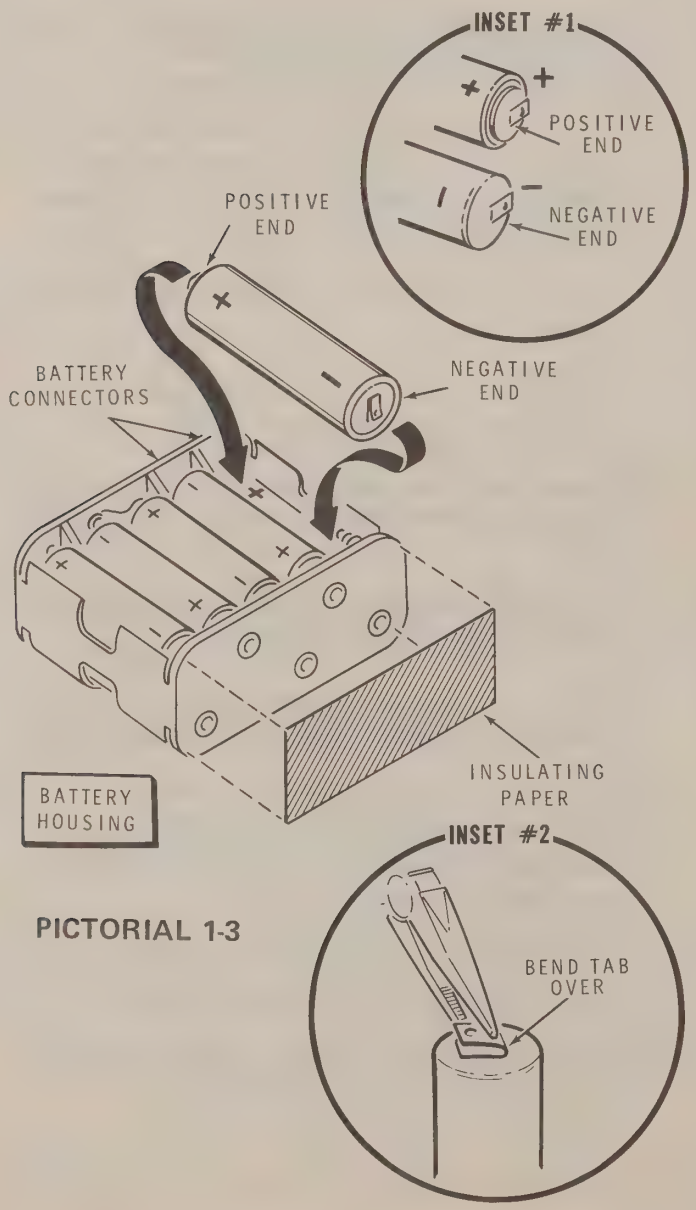
## CHARGER ASSEMBLY – Cont'd.

( ) Refer to Pictorial 1-2 (in the "Illustration Booklet") and position the power cord and the charging cable down flat in the notches in the charger base. Then place the charger top over the assembly as shown. Be sure the top is seated properly on the charger base; then secure the top to the base with two #4 x 3/4" self-tapping screws.

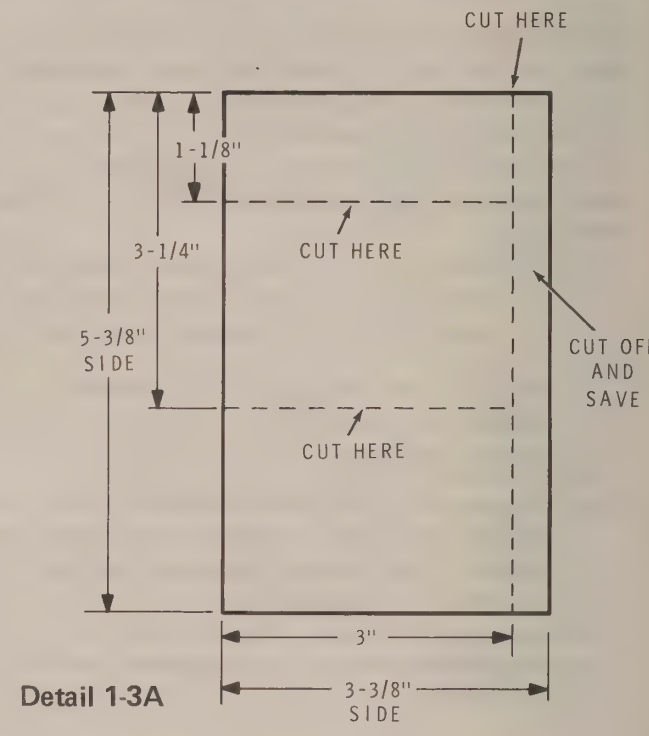
( ) Peel off the protective backing paper from the power label (#390-1221). Then press the label in place in the recessed area on the bottom of the charger.

NOTE: Complete the next step only if you wired your charger for 240 VAC operation.

( ) With a pen, change "120" to "240" on the charger label.




PICTORIAL 1-3




Detail 1-3A

Refer to Pictorial 1-3 for the following steps.

( ) Refer to Detail 1-3A and cut three pieces of insulating paper, with dimensions as shown, from the 5-3/8" x 3-3/8" sheet of insulating paper. Lay the two larger pieces and the long narrow piece aside temporarily.

( ) Locate the battery housing. Position it as shown in the Pictorial with the protruding battery connectors away from you.

( ) Peel off the backing paper from the 1-1/8" x 3" piece of insulating paper and press the insulating paper into place on the side of the battery housing as shown.

( ) Refer to inset drawing #1 on Pictorial 1-3 and identify the positive (+) and negative (–) ends of a battery cell.

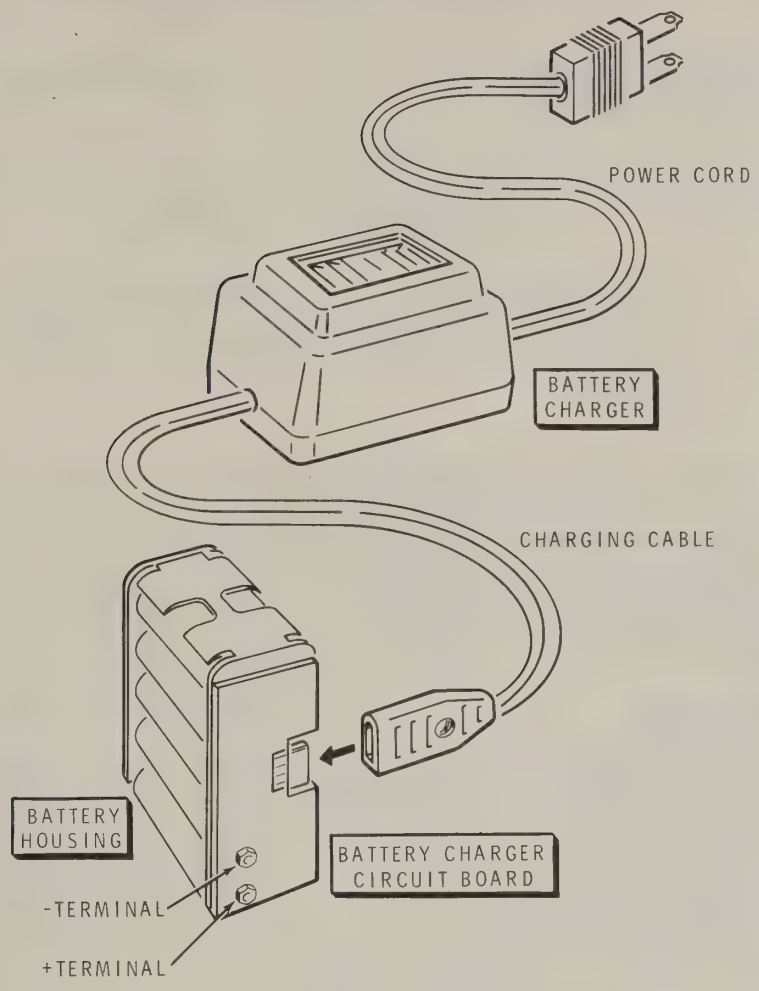
( ) Refer to inset drawing #2 on Pictorial 1-3 and fold the tab on each end of ten battery cells, if this is not already done.

( ) Install ten battery cells in the battery housing. IMPORTANT: Be sure to match the positive end of each cell with the (+) mark in the housing.

( ) Check to be sure that the spring at the negative end of each battery cell does not protrude beyond the edge of the battery housing. Push any exposed spring back down using a screwdriver.

The recommended way to charge the batteries is to use the charger furnished with this kit. Charge the batteries from 14 to 24 hours. (More than 24 hours will not add to the battery charge. However, this will not harm them.)

# BATTERY CHARGING




**PICTORIAL 1-4**

Refer to Pictorial 1-4 for the following steps:

( ) Plug the assembled battery charger circuit board onto the battery housing as shown.

( ) Use a voltmeter to measure the voltage across the terminals on the battery charger circuit board.

( ) Make a note of the actual reading. NOTE: This reading may be quite low because the battery cells will usually discharge if they are stored over a period of time.

( ) Plug the connector on the end of the charging cable into the socket on the circuit board.

( ) Connect the power cord plug to an AC outlet. This will permit the battery pack to charge while you assemble the Transceiver.

( ) The meter reading should increase.

( ) Disconnect the voltmeter leads.

NOTE: If you did not obtain the proper readings, refer to "Battery Pack Test" on Page 42. Otherwise, proceed to Page 20.

# TRANSCEIVER

## ASSEMBLY NOTES

*IMPORTANT: Before you start to assemble the main circuit board, it is very important that you read the following information on wiring, soldering, and step-by-step assembly procedures.*

1. The main circuit board has foil on both sides. Note that the "component" (or screened) side of the circuit board has the outline of each component screened on it. All components will be mounted on this side of the circuit board, and soldered to the other side of the circuit board. DO NOT solder on the component side of the circuit board.

2. The main circuit board is divided into six sections. Except for the switches, controls, and wires, all components will be installed in one section before you proceed to another section. An identification drawing at the top of each page will show which section of the circuit board you are installing components on.

3. Due to the small foil area around the circuit board holes, and the small area between the foils, be very careful to prevent solder bridges between adjacent foils. Use a minimum amount of solder and a 15-25 watt soldering iron with a small (1/8") tip. Allow the iron to reach operating temperature; then apply it only long enough to make a good solder connection. Also remember to keep the soldering iron tip clean.

4. Detail drawings of component installations are on two pages in the "Illustration Booklet." Remove these pages (Details 2-1A through 2-1X) from the Illustration Booklet. Then place these pages in a convenient location where you can refer to them as you are directed to them in a step.

## CONSTRUCTION HINTS

The assembly of this circuit board is not difficult; but it is time consuming. The following valuable hints will help you do a good assembly job.

A. Take your time when you assemble the circuit board. Work at a slow pace. Remember that accuracy is far more important than speed.

B. When you perform the steps in the circuit board Pictorials, identify each component and the location before you install the component. (It may be very difficult to locate an incorrectly installed component after the unit has been assembled.) Then position each component over its outline on the circuit board as shown in the proper Detail drawing.

C. After you have installed 3 or 4 components on the circuit board, solder each connection carefully. Then cut off excess lead lengths. Be careful not to cover up unused holes with solder or to form solder bridges between adjacent foils.

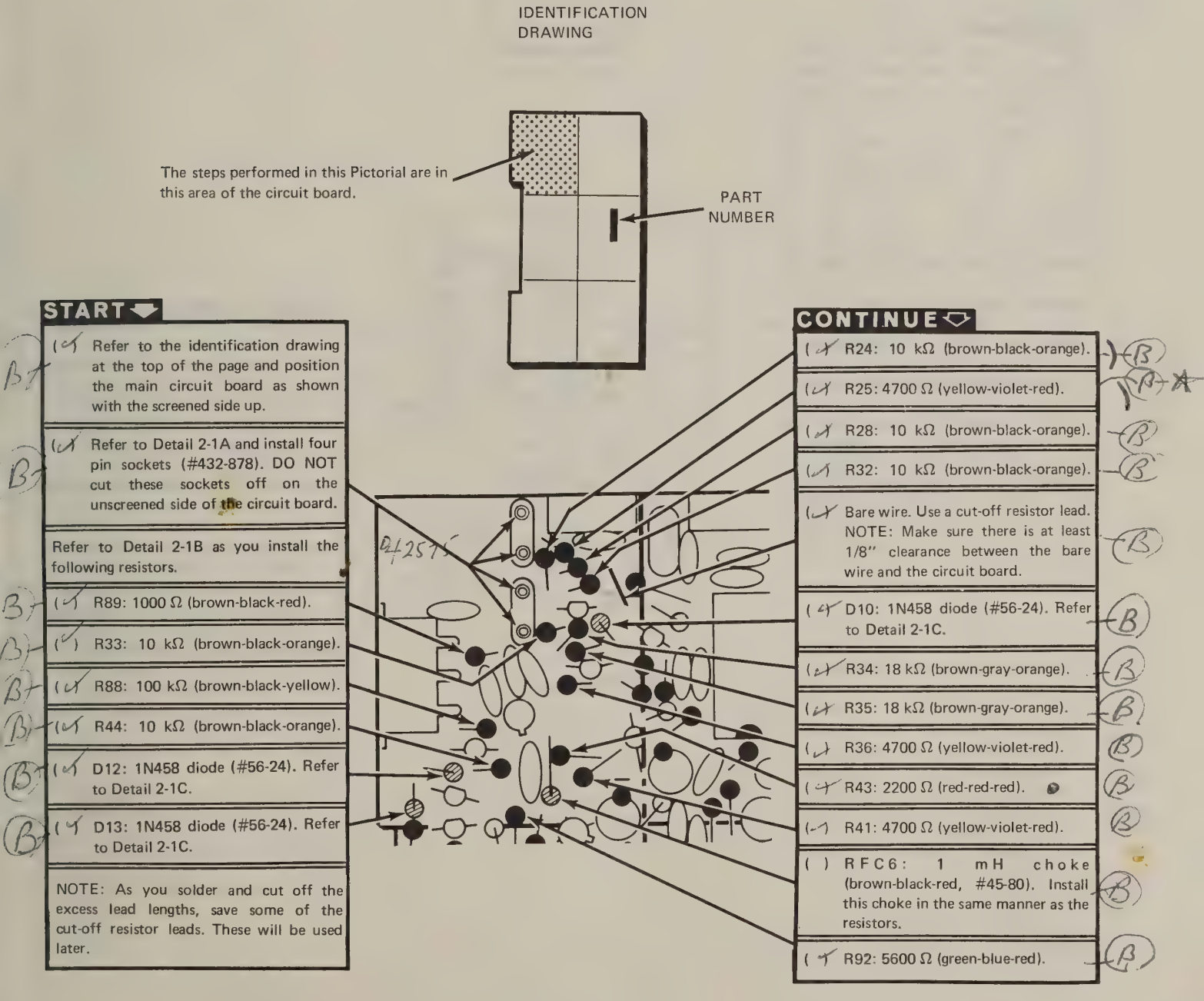
D. After you have completed the assembly of each of the six circuit board sections, position the shadow mask (#490-184) over the foil on the unscreened side of the circuit board. The foil pattern of the mask should cover up the foil on the board. Thus, any solder bridges between foils can easily be seen. If there is a solder bridge, refer to the "Instructions for use" of the Soder-Wick supplied with this kit, to remove the solder.

E. Take a short break after you have completed each one-half or a full section of the circuit board.

# STEP-BY-STEP ASSEMBLY

## MAIN CIRCUIT BOARD PARTS MOUNTING

NOTE: Be sure you have read the "Assembly Notes" (on the preceding page) before you perform the following steps. Then install components at the indicated locations and as shown in the appropriate mounting Details (Details 2-1A through 2-1X) in the "Illustration Booklet."




PICTORIAL 2-1

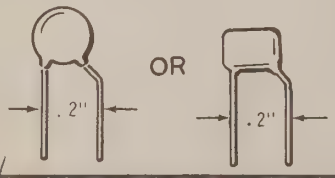
IDENTIFICATION DRAWING


The steps performed in this Pictorial are in this area of the circuit board.

**START**

( ) C43: 10 µF tantalum. Be SURE to position the plus (+) or color dot marked lead into the hole to the right, as shown.

NOTE: Before you install ceramic capacitors, form the leads of each capacitor as shown using a pair of long-nose pliers.



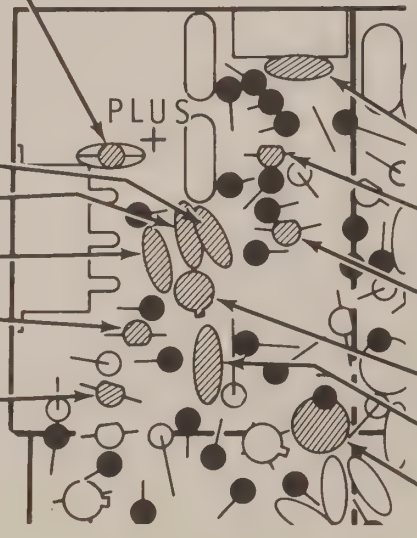

( ) C86: .01 µF (103) ceramic.

( ) C88: 150 pF (151) ceramic.

( ) C87: 36 pF ceramic.

( ) Q10: 2N3393 transistor (#417-118). Refer to Detail 2-1D.

( ) Q14: 2N5308 transistor (#417-222). Refer to Detail 2-1D.




**CONTINUE**

( ) C33: .047 µF (473) ceramic.

( ) Q6: 2N3393 transistor (#417-118). Refer to Detail 2-1D.

( ) Q7: 2N3393 transistor (#417-118). Refer to Detail 2-1D.

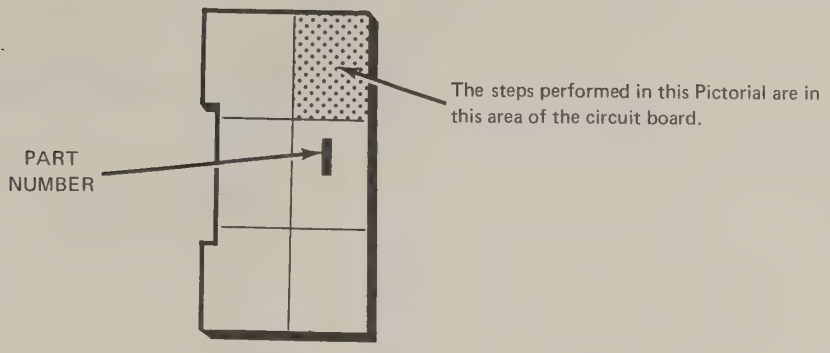
( ) Q20: UC734 transistor (#417-167). Refer to Detail 2-1E.

( ) C89: 47 pF ceramic.

( ) L11: .10 µH coil (red, #40-1784). Refer to Detail 2-1F.

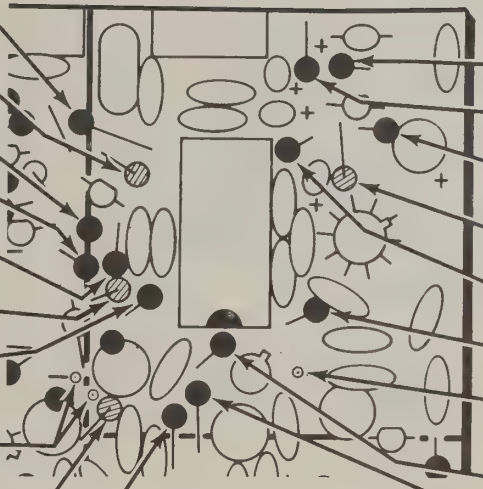
**PICTORIAL 2-2**

IDENTIFICATION DRAWING




**START**

- ( ) R22: 1000 Ω (brown-black-red).
- ( ) L6: 15 μH coil (#45-51). Refer to Detail 2-1G.
- ( ) R31: 4700 Ω (yellow-violet-red). Refer to Detail 2-1H.
- ( ) R37: 2200 Ω (red-red-red).
- ( ) R27: 330 Ω (orange-orange-brown).
- ( ) D9: 1N458 diode (#56-24). Refer to Detail 2-1C.
- ( ) R21: 47 Ω (yellow-violet-black).
- ( ) Refer to Detail 2-1J and install wire sockets (#432-134) at holes J and K.
- ( ) C94: .56 pF phenolic (green-blue-gray-silver). Install this capacitor in the same manner as the resistors.
- ( ) R96: 10 kΩ (brown-black-orange).



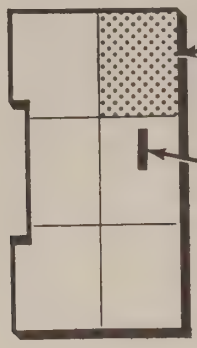
**CONTINUE**

- ( ) R39: 2200 Ω (red-red-red).
- ( ) R42: 2200 Ω (red-red-red).
- ( ) R38: 10 kΩ (brown-black-orange).
- ( ) D8: 1N458 diode (#56-24). Refer to Detail 2-1C.
- ( ) R23: 1000 Ω (brown-black-red).
- ( ) R19: 470 Ω (yellow-violet-brown).
- ( ) Refer to Detail 2-1K and install a connector pin (#432-121) at hole T.
- ( ) R97: 220 Ω (red-red-brown).
- ( ) R95: 47 kΩ (yellow-violet-orange).

PICTORIAL 2-3

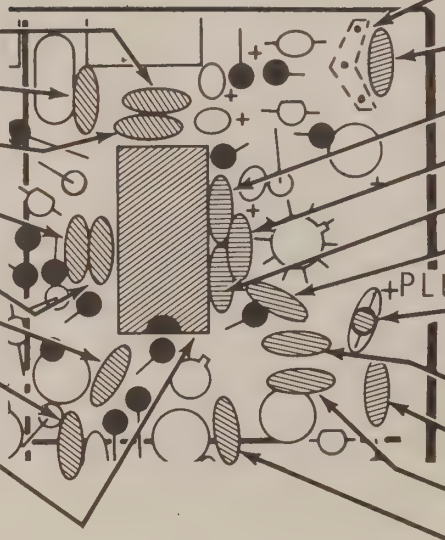
change R-21 To 1MH choke (45-80) (from 47Ω)

IDENTIFICATION DRAWING




**START**

- ( ) C31: .01 µF (103) ceramic.
- ( ) C28: 36 pF ceramic
- ( ) C25: 5 pF ceramic.
- ( ) C32: .01 µF (103) ceramic.
- ( ) C26: .01 µF (103) ceramic.
- ( ) C99: 470 pF (471) ceramic.
- ( ) C95: 10 pF ceramic.
- ( ) IC1: CA3089 IC (#442-92). Refer to Detail 2-1L.

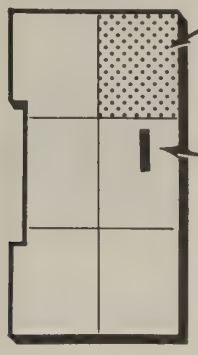



**CONTINUE**

- ( ) Refer to Detail 2-1K and install three connector pins (#432-121) at holes R, 1, and 2.
- ( ) C42: .1 µF (104) ceramic.
- ( ) C27: .01 µF (103) ceramic.
- ( ) C23: .01 µF (103) ceramic.
- ( ) C24: .01 µF (103) ceramic.
- ( ) C35: 47 pF ceramic.
- ( ) C38: 47 µF tantalum. Be SURE to position the plus (+) or color dot marked lead into the upper hole, as shown.
- ( ) C22: 150 pF (151) ceramic.
- ( ) C21: .01 µF (103) ceramic.
- ( ) C19: 47 pF ceramic.
- ( ) C98: 3.3 pF ceramic.

**PICTORIAL 2-4**

IDENTIFICATION DRAWING



The steps performed in this Pictorial are in this area of the circuit board.

PART NUMBER

**START**

( ) Y1: 10.7 MHz crystal (#404-402).

NOTE: Refer to Detail 2-1D for the next three steps.

( ) Q8: 2N3393 transistor (#417-118).

( ) Q5: 2N3393 transistor (#417-118).

( ) Q9: 2N3393 transistor (#417-118).

( ) L12: .15 µH coil (yellow, #40-1783). Refer to Detail 2-1F.

( ) L13: .15 µH coil (yellow, #40-1783). NOTE: This coil may be installed either way.

( ) L5: In the same manner, install a 7.5 µH coil (#40-1814).

**CONTINUE**

Refer to Detail 2-1M for the next five capacitors.

( ) C34: .68 µF tantalum.

( ) C36: 10 µF tantalum.

( ) C29: .68 µF tantalum.

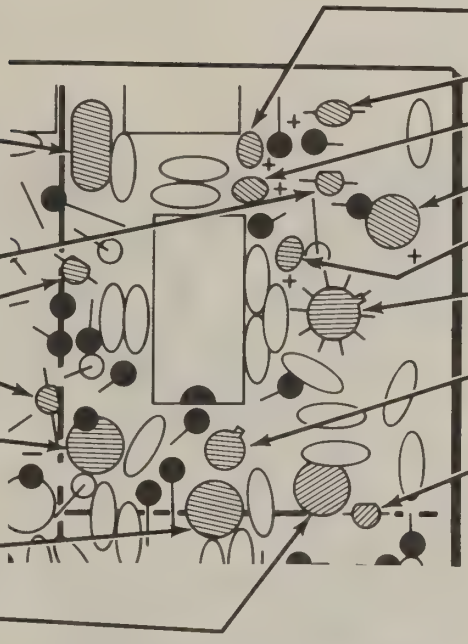
( ) C41: 150 µF tantalum.

( ) C37: 10 µF tantalum.

( ) IC2: MC1454 IC (#442-97). Refer to Detail 2-1N.

( ) Q22: 2N2369 transistor (#417-154). Refer to Part 2 of Detail 2-1E.

( ) Q4: MPS6520 transistor (#417-134). Refer to Detail 2-1D.



PICTORIAL 2-5

IDENTIFICATION DRAWING

The steps performed in this Pictorial are in this area of the circuit board.


**START**

- R91: 100 kΩ (brown-black-yellow).
- D1: 1N2071 diode (#57-27). Refer to Detail 2-1C.
- R51: 10 kΩ (brown-black-orange).
- R48: 4700 Ω (yellow-violet-red).
- R49: 1000 Ω (brown-black-red).
- R47: 1000 Ω (brown-black-red).
- R46: 22 kΩ (red-red-orange).
- D11: 1N458 diode (#56-24). Refer to Detail 2-1C.
- RFC1: 1 mH choke (brown-black-red, #45-80).
- R69: 4700 Ω (yellow-violet-red).
- D2: 1N2071 diode (#57-27). Refer to Detail 2-1C.
- R62: 100 kΩ (brown-black-yellow).
- R45: 1000 Ω (brown-black-red).

**CONTINUE**

- R93: 100 kΩ (brown-black-yellow).
- R94: 220 Ω (red-red-brown).
- R74: 220 Ω (red-red-brown).
- R73: 10 kΩ (brown-black-orange).
- R71: 100 Ω (brown-black-brown).
- RFC4: 1 mH choke (brown-black-red, #45-80).
- R66: 10 kΩ (brown-black-orange).
- R68: 33 kΩ (orange-orange-orange).
- R65: 47 kΩ (yellow-violet-orange).
- R63: 4700 Ω (yellow-violet-red).
- RFC2: 1 mH choke (brown-black-red, #45-80).

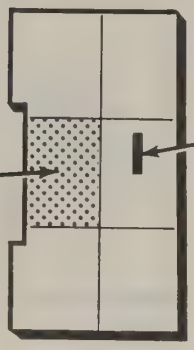
PICTORIAL 2-6

R-63 change to 6.8K Ω (from 4.7K)

R-65 Change to 330K (from 47KΩ)

3300

IDENTIFICATION DRAWING

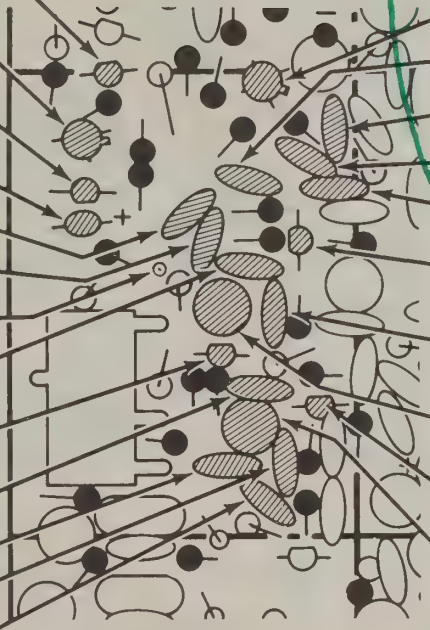


PART NUMBER

The steps performed in this Pictorial are in this area of the circuit board.

**START**

- Q13: 2N3393 transistor (#417-118). Refer to Detail 2-1D.
- Q12: 2N2369 transistor (#417-154). Refer to Part 2 of Detail 2-1E.
- Q11: X29A829 transistor (#417-201). Refer to Detail 2-1D.
- C39: 22 µF tantalum. Refer to Detail 2-1M.
- C56: 470 pF (471) ceramic.
- C66: 5 pF ceramic.
- Connector pin at Z. Refer to Detail 2-1K.
- C68: 3.3 pF ceramic.
- Q17: MPS6520 transistor (#417-134). Refer to Detail 2-1D.
- C64: 470 pF (471) ceramic.
- C65: .01 µF (103) ceramic.
- C62: 47 pF ceramic.
- C58: .01 µF (103) ceramic.



**CONTINUE**

- Q21: 40673 transistor (#417-240). Refer to Detail 2-1P.
- C72: 470 pF (471) ceramic.
- C91: .01 µF (103) ceramic.
- C93: .01 µF (103) ceramic.
- C73: 5 pF ceramic.
- Q18: MPS6520 transistor (#417-134). Refer to Detail 2-1D.
- C67: 470 pF (471) ceramic.
- L8: .15 µH coil (yellow, #40-1783). Refer to Detail 2-1F. NOTE: This coil may be installed either way.
- Q16: MPS6520 transistor (#417-134). Refer to Detail 2-1D.
- L7: .30 µH coil (violet-, #40-1785). This coil may be installed either way.

PICTORIAL 2-7

C-67 to 47pF (from 470pF) change

Remove From circuit

change to 417-293

Q17 - Q18

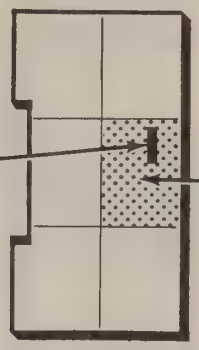
Use 417-293 - 2N5770 [instead of MPS6520 (417-134)]

Change C-64 to 47pF (from 470pF)

C39 {see C-21Y} V

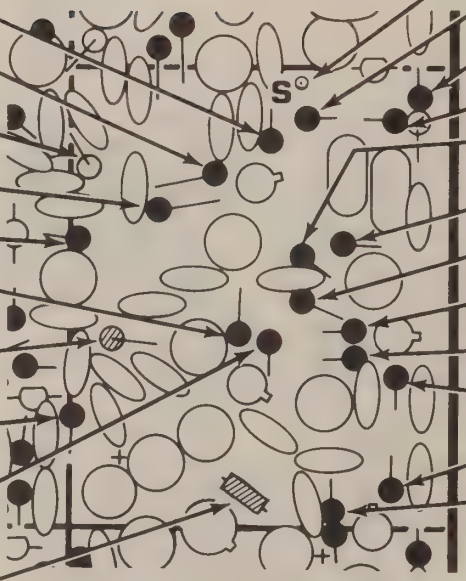
[add 10Ω R AT Neg END]

IDENTIFICATION DRAWING




**START**

- ( ) R101: 100 Ω (brown-black-brown).
- ( ) R99: 5600 Ω (green-blue-red).
- ( ) RFC7: 1 mH choke (brown-black-red, #45-80).
- ( ) R98: 22 kΩ (red-red-orange).
- ( ) R72: 47 kΩ (yellow-violet-orange).
- ( ) R102: 4700 Ω (yellow-violet-red).
- ( ) FB1: Refer to Detail 2-1Q and install a ferrite bead and a cut-off resistor lead.
- ( ) R67: 100 Ω (brown-black-brown).
- ( ) R103: Refer to Detail 2-1R and install a 10 Ω (brown-black-black) resistor.
- ( ) R104: 33 Ω (orange-orange-black). Form both leads as shown, using a pair of long-nose pliers. Position the resistor down against the circuit board.

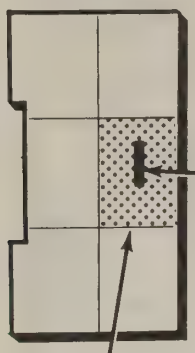




**CONTINUE**

- ( ) Refer to Detail 2-1K and install a connector pin (#432-121) at hole S.
- ( ) R16: 47 kΩ (yellow-violet-orange).
- ( ) R18: 100 Ω (brown-black-brown).
- ( ) R17: 4700 Ω (yellow-violet-red).
- ( ) R14: 10 Ω (brown-black-black).
- ( ) R15: 8200 Ω (gray-red-red).
- ( ) R11: 47 kΩ (yellow-violet-orange).
- ( ) R12: 5600 Ω (green-blue-red).
- ( ) R9: 47 kΩ (yellow-violet-orange).
- ( ) R13: 100 Ω (brown-black-brown).
- ( ) R8: 220 Ω (red-red-brown).
- ( ) R5: 47 kΩ (yellow-violet-orange).

**PICTORIAL 2-8**

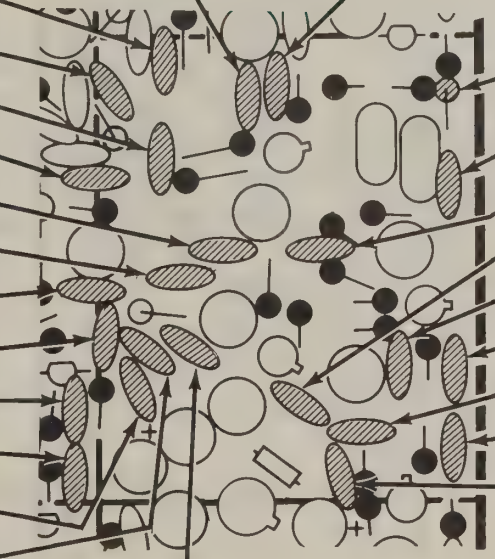
IDENTIFICATION DRAWING




The steps performed in this Pictorial are in this area of the circuit board.

**START**

- ( ) C101: 5 pF ceramic.
- ( ) C96: 47 pF ceramic.
- ( ) C92: 20 pF ceramic.
- ( ) C97: 470 pF (471) ceramic.
- ( ) C71: 5 pF ceramic.
- ( ) C103: 47 pF ceramic.
- ( ) C17: 5 pF ceramic.
- ( ) C69: .01 µF (103) ceramic.
- ( ) C63: .01 µF (103) ceramic.
- ( ) C61: 47 pF ceramic.
- ( ) C57: 47 pF ceramic.
- ( ) C107: 470 pF (471) ceramic.
- ( ) C106: 10 pF ceramic.
- ( ) C105: 47 pF ceramic.



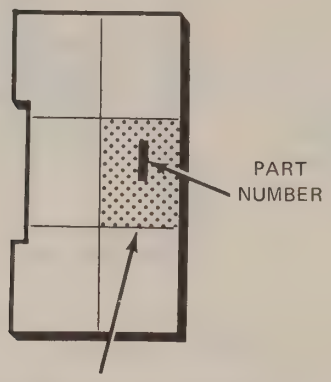
**CONTINUE**

- ( ) C102: 470 pF (471) ceramic.
- ( ) C18: 2.2 pF phenolic (red-red-white). Form the leads as shown, using a pair of long-nose pliers. Position the capacitor down against the circuit board.

- ( ) C16: 36 pF ceramic.
- ( ) C14: .01 µF (103) ceramic.
- ( ) C104: 470 pF (471) ceramic.
- ( ) C13: 3.3 pF ceramic.
- ( ) C15: .01 µF (103) ceramic.
- ( ) C11: 5 pF ceramic.
- ( ) C9: 470 pF (471) ceramic.
- ( ) C5: 470 pF (471) ceramic.

**PICTORIAL 2-9**

IDENTIFICATION DRAWING

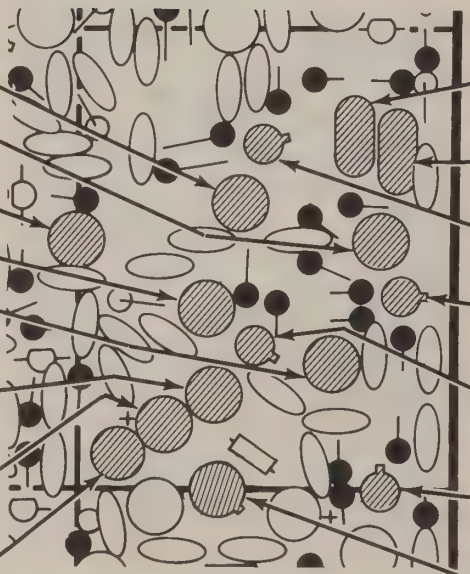



The steps performed in this Pictorial are in this area of the circuit board.

**START**

Refer to Detail 2-1F for the following steps. NOTE: The coils may be installed either way.

- (✓) L14: .15 µH coil (yellow, #40-1783).
- (✓) L4: 7.5 µH coil (#40-1814).
- (✓) L9: .12 µH coil (orange, 3-1/2 turns, #40-1782).
- (✓) L15: .10 µH coil (red, #40-1784).
- (✓) L3: .15 µH coil (yellow, #40-1783).
- (✓) L16: .10 µH coil (red, #40-1784). Use the alignment tool to remove the coil core. NOTE: If one of the cores should ever break, you may replace it with this core.
- (✓) L17: .12 µH coil (orange, 3-1/2 turns, #40-1782). Remove and save the core.
- ( ) C112: 10 µF tantalum. Refer to Detail 2-1M.



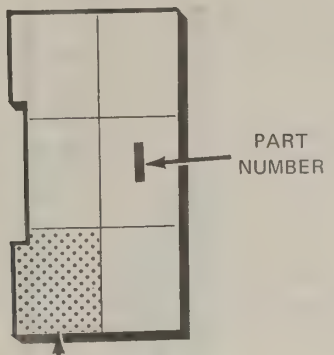
**CONTINUE**

- (✓) FL2: 10.7 MHz crystal filter (#404-535).
- (✓) FL1: 10.7 MHz crystal filter (#404-535).
- (✓) Q23: 2N2369 transistor (#417-154). Refer to Part 2 of Detail 2-1E.
- (✓) Q3: 40673 transistor (#417-240). Refer to Detail 2-1P.
- (✓) Q24: 2N2369 transistor (#417-154). Refer to Part 2 of Detail 2-1E.
- (✓) Q2: 40673 transistor (#417-240). Refer to Detail 2-1P.
- (✓) Q25: 2N2369 transistor (#417-154). Refer to Part 2 of Detail 2-1E.

**PICTORIAL 2-10**

change Q2 to 417-274 from 417-240

IDENTIFICATION DRAWING




The steps performed in this Pictorial are in this area of the circuit board.

**START**

( ) Refer to Detail 2-1C and install 10 pin sockets (#432-878). DO NOT cut these pins off on the unscreened side of the circuit board.

Refer to Detail 2-1S and install five 3.2-18 pF trimmer capacitors at:

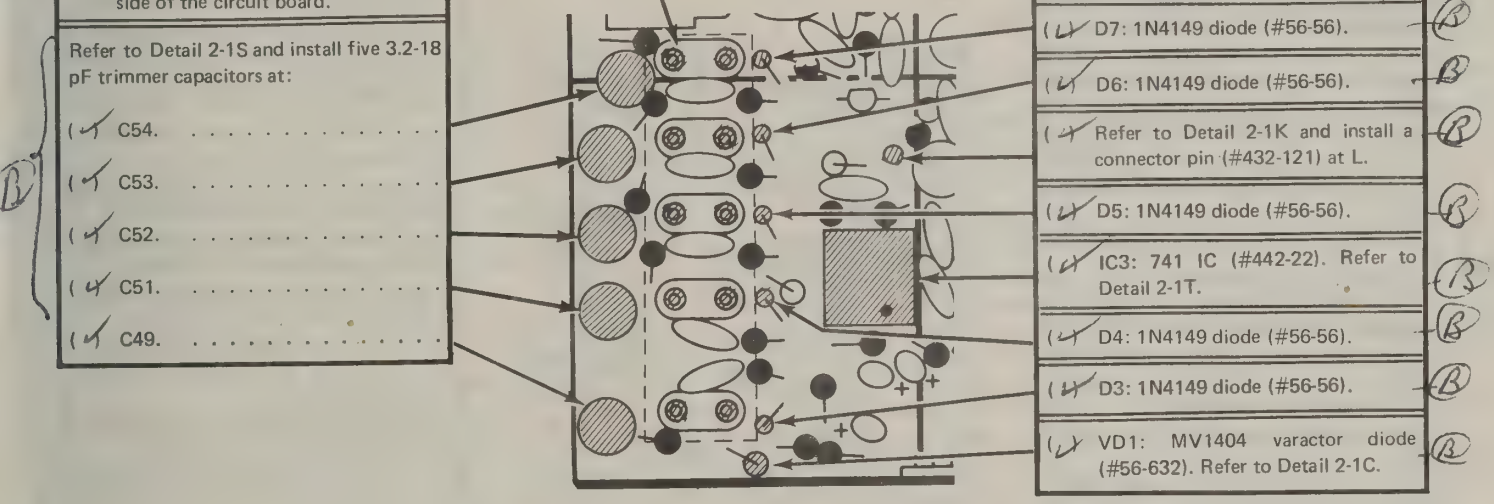
( ) C54. . . . . .

( ) C53. . . . . .

( ) C52. . . . . .

( ) C51. . . . . .

( ) C49. . . . . .



**CONTINUE**

NOTE: Refer to Detail 2-1C when you install the following diodes. Be sure to install each diode with its banded end up.

( ) D7: 1N4149 diode (#56-56).

( ) D6: 1N4149 diode (#56-56).

( ) Refer to Detail 2-1K and install a connector pin (#432-121) at L.

( ) D5: 1N4149 diode (#56-56).

( ) IC3: 741 IC (#442-22). Refer to Detail 2-1T.

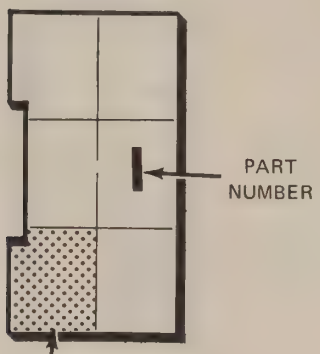
( ) D4: 1N4149 diode (#56-56).

( ) D3: 1N4149 diode (#56-56).

( ) VD1: MV1404 varactor diode (#56-632). Refer to Detail 2-1C.

**PICTORIAL 2-11**

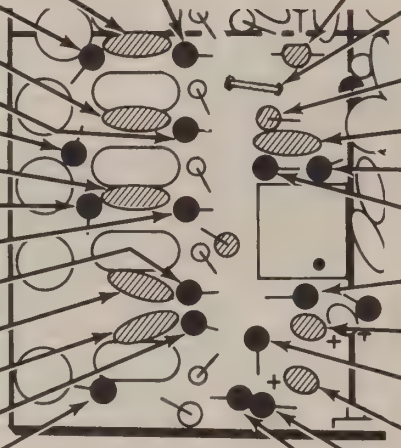
IDENTIFICATION DRAWING




The steps performed in this Pictorial are in this area of the circuit board.

**START**

- ( ) R61: 4700 Ω (yellow-violet-red).
- ( ) C48: .01 µF (103) ceramic.
- ( ) R59: 100 kΩ (brown-black-yellow).
- ( ) C47: .01 µF (103) ceramic.
- ( ) R58: 4700 Ω (yellow-violet-red)
- ( ) R57: 100 kΩ (brown-black-yellow).
- ( ) C46: .01 µF (103) ceramic.
- ( ) R55: 100 kΩ (brown-black-yellow).
- ( ) R56: 4700 Ω (yellow-violet-red).
- ( ) R54: 4700 Ω (yellow-violet-red).
- ( ) C45: .01 µF (103) ceramic.
- ( ) C44: .01 µF (103) ceramic.
- ( ) R52: 4700 Ω (yellow-violet-red).
- ( ) R53: 100 kΩ (brown-black-yellow).

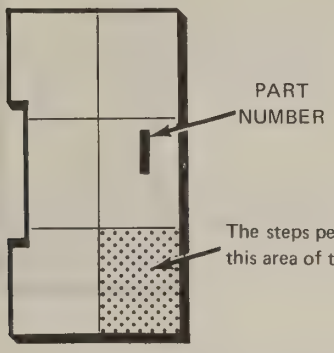


**CONTINUE**

- ( ) Q15: MPS6521 transistor (#417-172). Refer to Detail 2-1D.
- ( ) Bare wire. Use a cut-off resistor lead. Make sure there is at least 1/8" clearance between the bare wire and the circuit board.
- ( ) FB2: Refer to Detail 2-1Q and install a ferrite bead and a cut-off resistor lead.
- ( ) C74: .01 µF (103) ceramic.
- ( ) R82: 4700 Ω (yellow-violet-red).
- ( ) R81: 4700 Ω (yellow-violet-red).
- ( ) R83: 1 MΩ (brown-black-green).
- ( ) C82: .68 µF tantalum. Refer to Detail 2-1M.
- ( ) R85: 5600 Ω (green-blue-red).
- ( ) C85: .68 µF tantalum. Refer to Detail 2-1M.
- ( ) R86: 1800 Ω (brown-gray-red).
- ( ) RFC5: 1 mH choke (brown-black-red, #45-80).

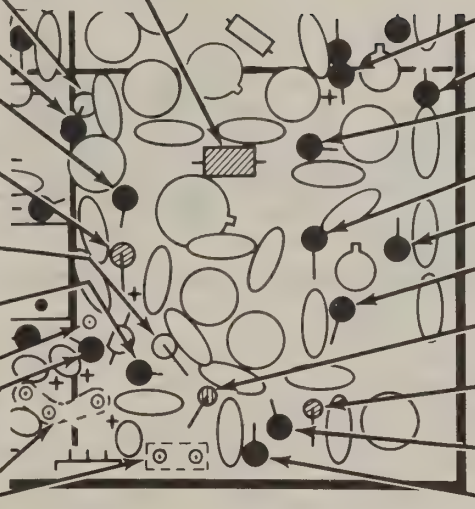
**PICTORIAL 2-12**

IDENTIFICATION DRAWING




**START**

- (✓) RFC8: Ferrite bead choke. Refer to Detail 2-1U.
- Refer to Detail 2-1V for the next two steps.
- (✓) RFC3: 1 mH choke (brown-black-red, #45-80).
- (✓) R64: 680 Ω, 10% (blue-gray-brown).
- (✓) R78: 2200 Ω (red-red-red).
- (✓) C78: .22 µF tantalum. NOTE: Install this capacitor with the plus (+) marked end up.
- (✓) RFC9: Ferrite bead choke. Refer to Detail 2-1U. Install this choke on end.
- (✓) R77: 33 kΩ (orange-orange-orange).
- (✓) Refer to Detail 2-1K and install a connector pin (#432-121) at hole H.
- (✓) R79: 1000 Ω (brown-black-red).
- (✓) Refer to Detail 2-1K and install connector pins (#432-121) at holes Y, G, F, N, and P.

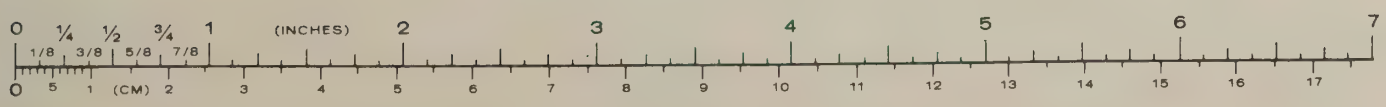


**CONTINUE**

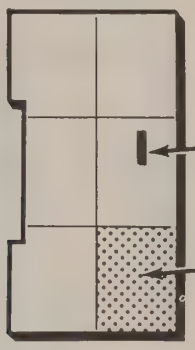
- ( ) R6: 12 kΩ (brown-red-orange).
- ( ) R7: 47 kΩ (yellow-violet-orange).
- ( ) R3: 10 Ω (brown-black-black).
- ( ) R1: 47 kΩ (yellow-violet-orange).
- ( ) R4: 220 Ω (red-red-brown).
- ( ) R2: 12 kΩ (brown-red-orange).
- ( ) D15: 1N458 diode (#56-24). Refer to Detail 2-1C.
- ( ) D14: 1N458 diode (#56-24). Refer to Detail 2-1C.
- ( ) R75: 4700 Ω (yellow-violet-red).
- ( ) R76: 1500 Ω (brown-green-red).

PICTORIAL 2-13

R-64 changed 1KΩ (From 680Ω)



IDENTIFICATION DRAWING




**START**

- C59: 150 pF (151) ceramic.
- C108: 10 pF ceramic.
- C113: 10 pF ceramic.
- C81: 470 pF (471) ceramic.
- C79: .047 µF (473) ceramic.
- C109: 470 pF (471) ceramic.
- C77: .68 µF tantalum. Refer to Detail 2-1M.
- C114: 15 pF ceramic.
- C83: .01 µF (103) ceramic.
- C84: .68 µF tantalum. Refer to Detail 2-1M.
- C116: 3.3 pF ceramic.
- C76: 470 pF (471) ceramic.

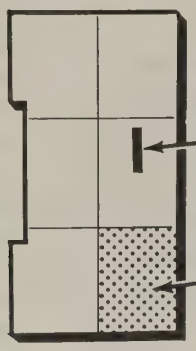
**CONTINUE**

- C111: 3.3 pF ceramic.
- C3: 470 pF (471) ceramic.
- C7: 3.3 pF ceramic.
- C6: 5 pF ceramic.
- C4: 470 pF (471) ceramic.
- C115: 15 pF ceramic.
- C2: 5 pF ceramic.
- C1: 470 pF (471) ceramic.
- C8: 470 pF (471) ceramic.
- C75: 470 pF (471) ceramic.

**PICTORIAL 2-14**

omitted

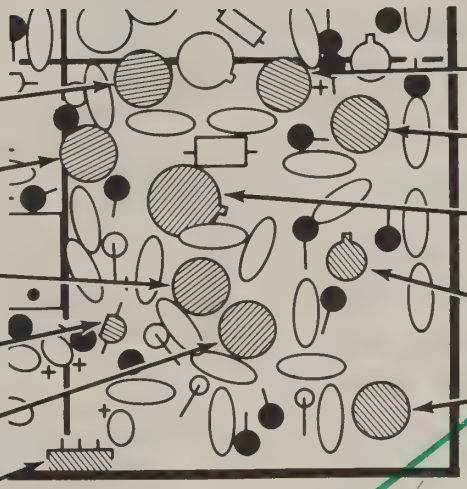
IDENTIFICATION DRAWING




**START**

Refer to Detail 2-1F when you install the following coils. NOTE: These coils may be installed either way.

- ( ) L18: .10 µH coil (red, #40-1784).
- ( ) L19: .08 µH coil (brown, 1-1/2 turns, #40-1838). Remove and save the core.
- ( ) L21: .15 µH coil (yellow, #40-1783).
- ( ) Q19: MPF105 transistor (#417-169). Refer to Detail 2-1D.
- ( ) L22: .12 µH coil (orange, 3-1/2 turns, #40-1782).
- ( ) R84: 10 kΩ miniature control (#10-1039). Refer to Detail 2-1W.



**CONTINUE**

- ( ) C12: 10 µF tantalum. Refer to Detail 2-1M.
- ( ) L2: .15 µH coil (yellow, #40-1783).
- ( ) Q26: 2N5913 or PT8831 transistor (#417-850) and heat sink. Refer to Detail 2-1X.
- ( ) Q1: 40673 transistor (#417-240). Refer to Detail 2-1P.
- ( ) L1: .15 µH coil (yellow, #40-1781). NOTE: This coil has three leads.

**CIRCUIT BOARD CHECKOUT**

Carefully inspect the circuit board for the following conditions.

- ( ) Unsoldered connections.
- ( ) "Cold" solder connections.
- ( ) Solder bridges between foil patterns. Use the shadow mask supplied with this kit.
- ( ) Protruding leads which could touch together. No leads should be longer than 1/8".
- ( ) Diodes for the correct position of the banded end. NOTE: Each diode on this circuit board MUST be installed so its banded end is up, as shown in Detail 2-1C.
- ( ) IC's for proper positioning and installation.
- ( ) Transistors for the proper type and installation.
- ( ) Tantalum capacitors for the correct position of the positive (+) lead.

**FINISH**

PICTORIAL 2-15

## CABLE PREPARATION

NOTES:

1. The cable preparation illustration, Detail 2-16A, is a full-size drawing. Use this drawing when you prepare the 8-wire cable.

2. After the cable wires are cut to the proper lengths, remove 1/4" of insulation from each end of each wire. Twist together the strands and apply a small amount of solder to the wire ends to hold the strands together.

3. Save the cut-off lengths of wire for use later.

( ) Cut an 11" length of 8-wire cable.

( ) Refer to Detail 2-16A (in the "Illustration Booklet"), lay the cable over the Detail, and prepare the wires so they match the outline. Prepare end A first; then end B.

( ) Lay the prepared 8-wire cable aside until it is called for in a step.

## MAIN CIRCUIT BOARD WIRING

Refer to Pictorial 2-16 (in the "Illustration Booklet") for the following steps.

NOTES:

1. To prepare a wire, as in the next step, cut the wire to the indicated length and remove 1/4" of insulation from each end. Then twist the strands together and melt a small amount of solder on the bare wire ends to hold the strands together.

2. In the following steps, (NS) means not to solder because other wires will be added later. "S-" with a number, such as (S-3), means to solder the connection. The number following the "S" tells how many wires are at the connection.

( ) Prepare the following lengths of wire from the flat cable that is left over:

1-1/2" orange
6-1/2" gray

( ) Connect one end of a 1-1/2" orange wire to the empty hole near Z on the circuit board (S-1).

( ) Refer to inset drawing #1 on Pictorial 2-16 and install a 3/4" long cut-off resistor lead in each of the three holes within the outline of switch SW1. About 3/8" of each lead must protrude through the board on the component side. Solder each lead to the foil of the board. Cut off the excess lead lengths on the foil side of the circuit board.

( ) SW1: Refer to inset drawing #1 on Pictorial 2-16 and mount the pushbutton switch at SW1 with two 2-56 x 3/8" screws, and two 2-56 nuts. Make sure half the length of the switch pushbutton protrudes beyond the edge of the circuit board before you tighten the screws. Position each of the three leads installed within the outline of SW1 so they touch the proper switch lugs. Then cut off the excess lead lengths. Solder only the lead connected to switch lug 1.

( ) Solder the free end of the 1-1/2" orange wire to lug 2 of the pushbutton switch (S-2).

( ) Connect one end of a 6-1/2" gray wire to lug 3 of the pushbutton switch (S-2).

Route the free end of the 6-1/2" gray wire as shown in the Pictorial and connect it to circuit board hole B+ (S-1).

( ) Refer to inset drawing #2 on Pictorial 2-16. Then solder a 1/2"-long cut-off resistor lead between the case and lug 3 of the 5000 Ω (5k) control with switch, as shown.

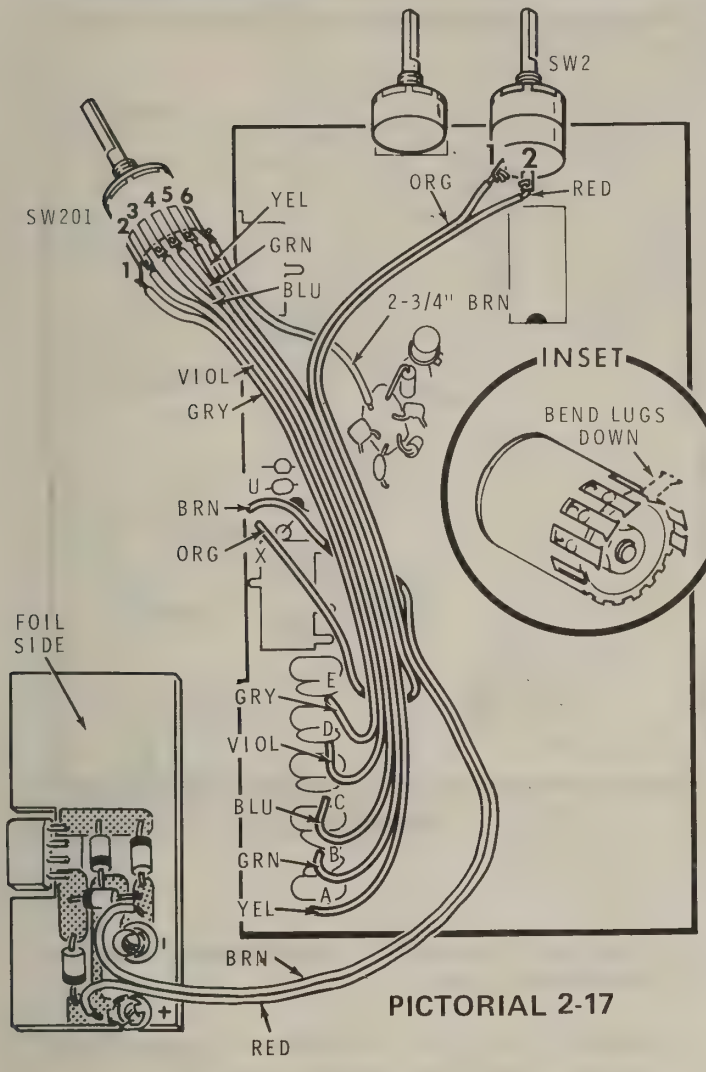
( ) R29/SW2: Mount the 5000 Ω (5k) control with switch (#19-714) to the indicated place on the circuit board. If necessary, bend the two capacitors mounted behind the outline of the control down so they do not interfere with the control. Solder the lugs to the foil.

( ) R26: In the same manner, mount the 5000 Ω (5k) control (#10-1040) to the circuit board.

( ) Y7: Locate the 10.7 MHz crystal (#404-562) and plug it into the socket pins as indicated on the Pictorial. The crystal may be installed either way.

( ) Y8: Plug in the 10.1 MHz crystal (#404-563).

( ) Install a 1" long cutoff resistor lead in each of the three holes within the outline of switch SW3. Make sure 3/4" of each lead is on the component side of the circuit board. Solder each lead to the foil of the board. NOTE: Make sure the three leads are perpendicular to the circuit board. Cut off the excess lead lengths on the foil side of the board.




PICTORIAL 2-17

Refer to Pictorial 2-17 for the following steps.

( ) Refer to the inset drawing on the Pictorial and carefully bend each of the six switch lugs with a finger until they are straight and parallel with the switch body.

( ) Prepare a 2-3/4" brown wire from the wire that was cut off the 8-wire cable.

( ) Connect one end of this wire to lug 6 of rotary switch SW201 (S-1).

Connect end A of the 8-wire cable to rotary switch SW201 as follows:

( ) Gray wire to lug 1 (S-1).

( ) Violet wire to lug 2 (S-1).

( ) Blue wire to lug 3 (S-1).

( ) Green wire to lug 4 (S-1).

( ) Yellow wire to lug 5 (S-1).

( ) Connect the brown wire at end A of the 8-wire cable to circuit board hole U (S-1).

The orange and the red wires at end A of the 8-wire cable, and the brown wire coming from switch SW201, will be connected later.

Connect end B of the 8-wire cable to the circuit board as follows:

( ) Orange wire to hole X (S-1).

( ) Gray wire to hole E (S-1).

( ) Violet wire to hole D (S-1).

( ) Blue wire to hole C (S-1).

( ) Green wire to hole B (S-1).

( ) Yellow wire to hole A (S-1).

NOTE: There are 11 unused smaller holes and 3 larger holes in the circuit board.

( ) Unplug the connector on the end of the charging cable from the socket on the battery charger circuit board.

( ) Position the battery charger circuit board, foil side up, as shown in the Pictorial.

Connect the remaining wires at end B of the 8-wire cable to the foil side of the charger circuit board as follows:

(X) Red wire to the hole at the positive (+) battery connector (S-1).

(X) Brown wire to the hole at the negative (–) battery connector (S-1).

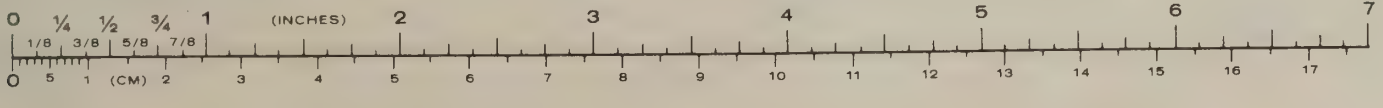
( ) Connect the brown wire coming from rotary switch SW201 lug 6 to the remaining empty hole at the location shown in Pictorial 2-17.

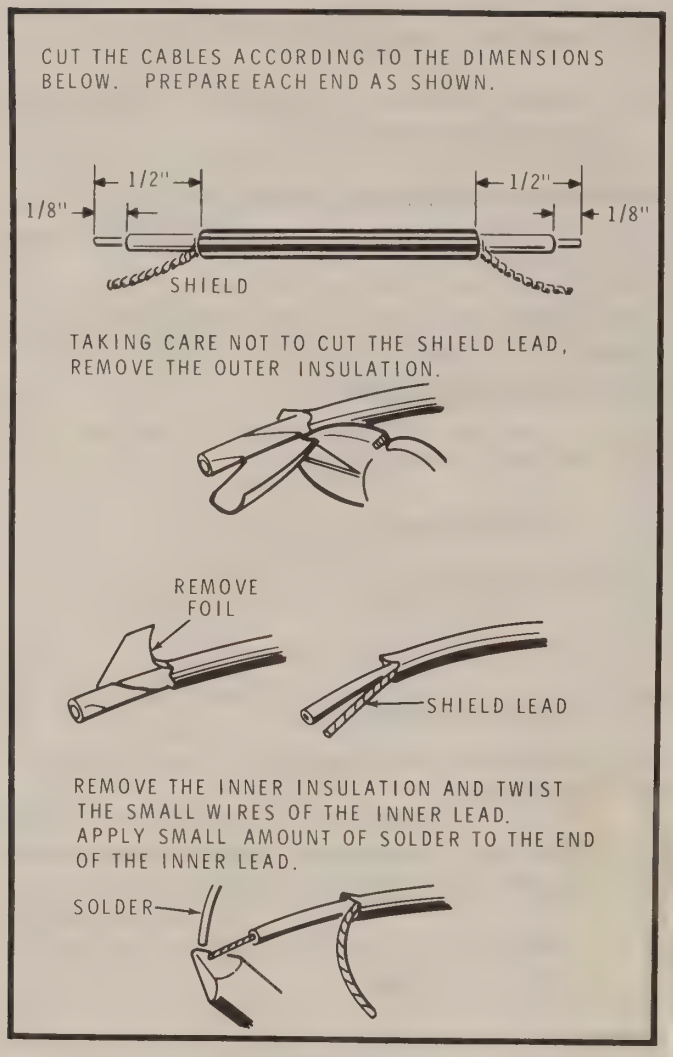
( ) Connect the orange wire coming from end A of the 8-wire cable to switch SW2 lug 1 (S-1).

( ) Connect the red wire coming from end A of the 8-wire cable to switch SW2 lug 2 (S-1).

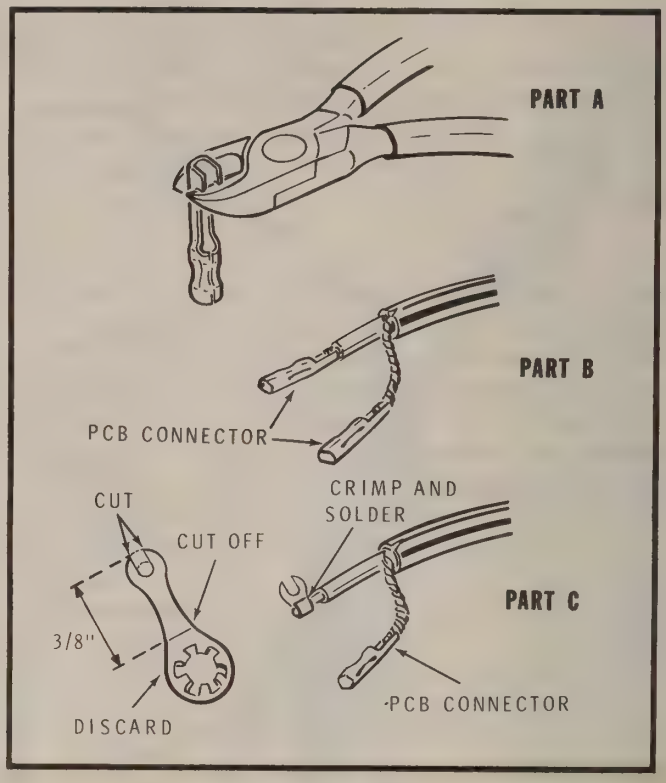
( ) Y2: Plug in the 15.1377 MHz crystal (#404-564, shown in Pictorial 2-16 in the "Illustration Booklet.")

Set the main circuit board assembly aside until it is called for in a step.






**Detail 3-1A**




**Detail 3-1B**

## CASE TOP ASSEMBLY

Refer to Pictorial 3-1 (in the "Illustration Booklet") for the following steps.

( ) Peel off the backing paper from a 2-1/8" x 3" piece of insulating paper. Then press the paper into place inside the case top at the location shown.

( ) Refer to Detail 3-1A and prepare one 6", one 5-1/2", and one 2" length of coaxial cable.

( ) Refer to Part A of Detail 3-1B and prepare ten PCB connectors (#432-120) by cutting off the end with the tabs as shown.

( ) Refer to Part B of Detail 3-1B and install PCB connectors on only one end of the 6" and the 5-1/2" cables.

( ) Install a PCB connector on the shield lead on only one end of the 2" cable.

( ) Refer to Part C of Detail 3-1B and prepare a small spade lug from a #10 solder lug as shown.

( ) Install the small spade lug on the center lead of the 2" cable.

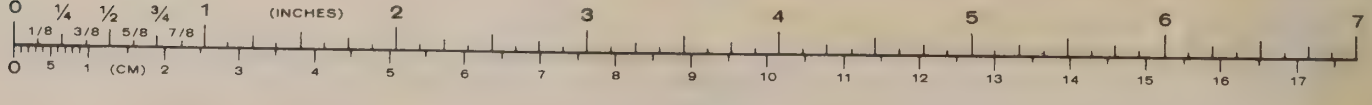
( ) Temporarily set aside the 6" and 2" cables.

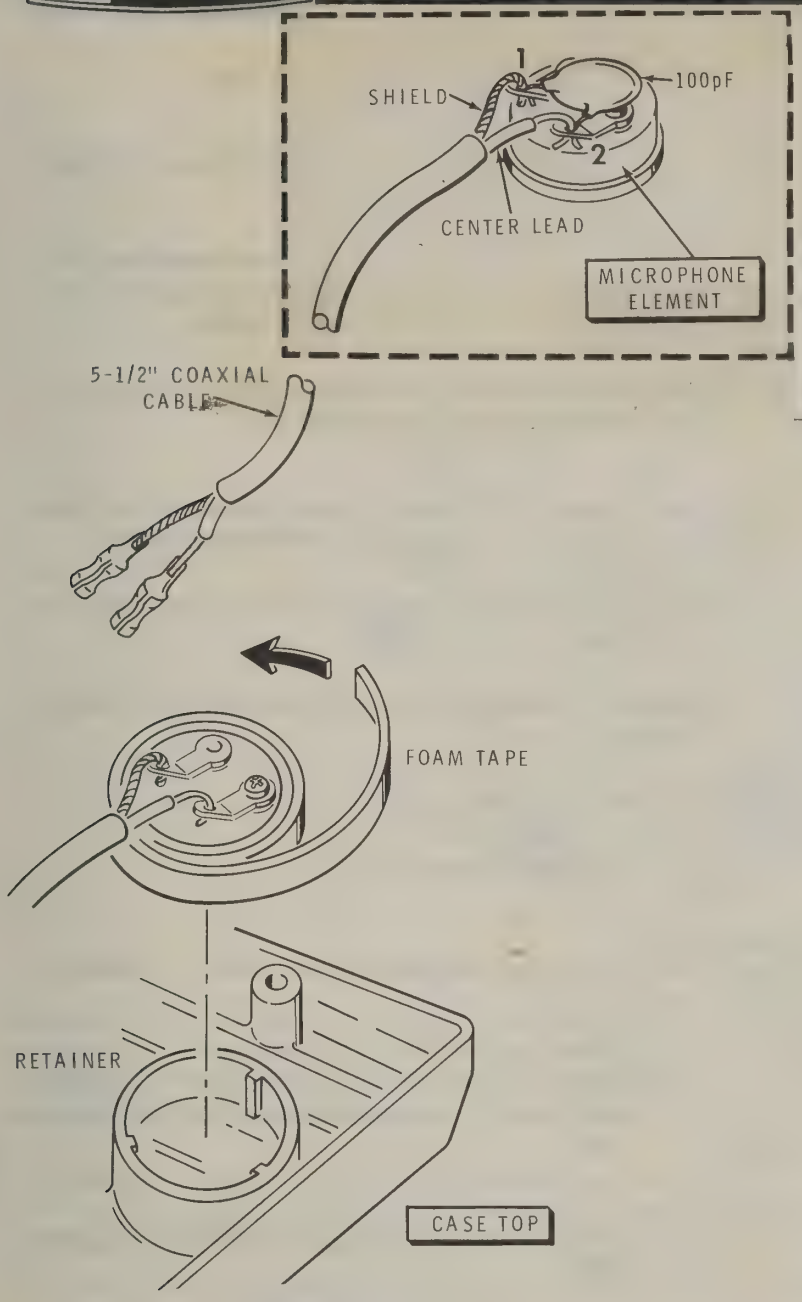
NOTE: In the following steps, DO NOT remove the black felt-type paper from the front of the microphone element.

( ) Refer to Detail 3-1C and connect the shield lead of the 5-1/2" cable to microphone element lug 1 (NS), and connect the inner lead to lug 2 (NS). NOTE: Make sure the inner lead does not touch the case of the element.

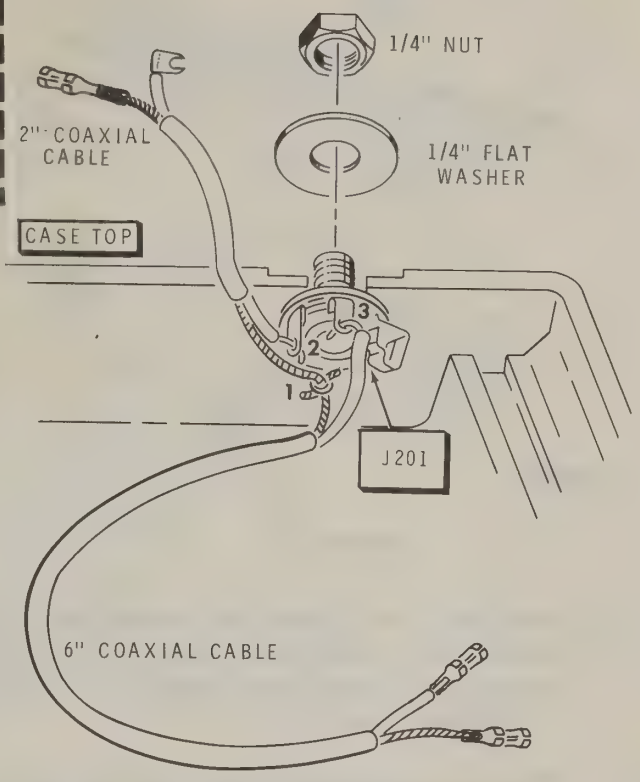
( ) Cut both leads of a 100 pF capacitor to 1/8". Then lay the capacitor down flat on the microphone element as shown in the Detail. Connect one lead to lug 1 (S-2) and the other lead to lug 2 (S-2).

( ) Cut a 9-1/2" piece of foam tape.






**Detail 3-1C**




**Detail 3-1D**

NOTE: In the following step be sure you do not wrap the foam tape over the ridge around the front edge of the microphone element.

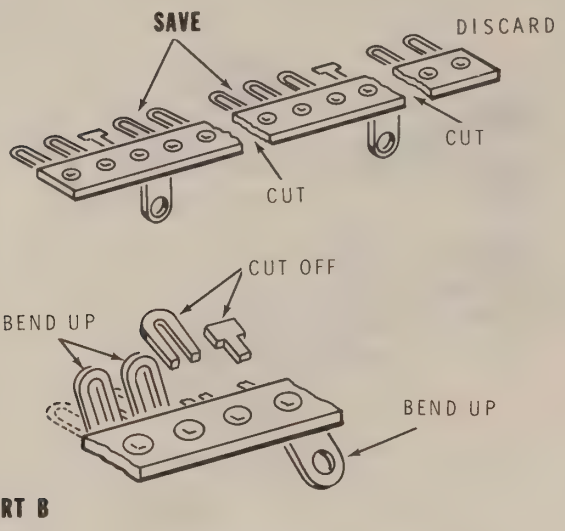
(1) Peel the paper backing from the foam tape and wrap the full length of tape tightly around the microphone element as shown.

(2) Position the microphone element as shown in Detail 3-1C, and then push it firmly into place in the retainer. NOTE: You may find it helpful to use a screwdriver to push the foam tape down at the ribs in the retainer wall.

(1) Refer to Detail 3-1D and connect the inner lead at the free end of the 6" coaxial cable to antenna jack J201 lug 3 (S-1). Connect the shield lead to lug 1 (NS).

(2) Connect the inner lead at the free end of the 2" coaxial cable to jack J201 lug 2 (S-1). Connect the shield lead to lug 1 (S-2).

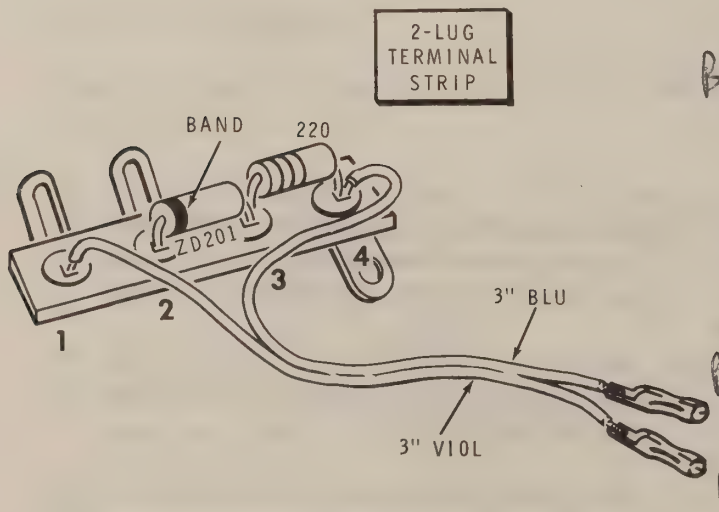
(3) J201: Mount the prewired antenna jack in the U-shaped slot in the side of the case top with a 1/4" flat washer and a 1/4" nut. Position the antenna jack lugs as shown in the Detail before you tighten the nut. Tighten the nut until the threaded portion of the jack just extends beyond the top surface of the nut.




Detail 3-1E

( ) Refer to Part A of Detail 3-1E and prepare an 11-lug terminal strip. You can use diagonal cutters to cut through the terminal strip insulator. Only the parts marked "save" will be used.

( ) Prepare the 4-lug terminal strip as shown in Part B of the Detail by cutting off the two indicated lugs. Then bend the three lugs up as shown. You will use this terminal strip in the following step.




Detail 3-1F

Refer to Detail 3-1F for the following steps.

Connect the following components and wires, as directed, in the eyelets of the 2-lug terminal strip.

( ) ZD201: Connect the lead at the banded end of a VRS-5A zener diode (#56-54) to eyelet 2 (S-1). Connect the other lead to eyelet 3 (NS).

( ) R201: Connect a 220 Ω (red-red-brown) resistor from eyelet 3 (S-2) to eyelet 4 (NS).

( ) Prepare a 3" length of 2-wire blue and violet cable from the wires that were cut off the 8-wire cable.

( ) Install PCB connectors on only one end of the 2-wire cable.

Connect the free end of the 2-wire blue and violet cable as follows:

( ) Blue wire to eyelet 4 (S-2).

( ) Violet wire to eyelet 1 (S-1).

Set the prewired terminal strip aside until it is called for later.

( ) Prepare a 3-1/2" length of 2-wire yellow and green cable from the wires that were cut off the 8-wire cable.

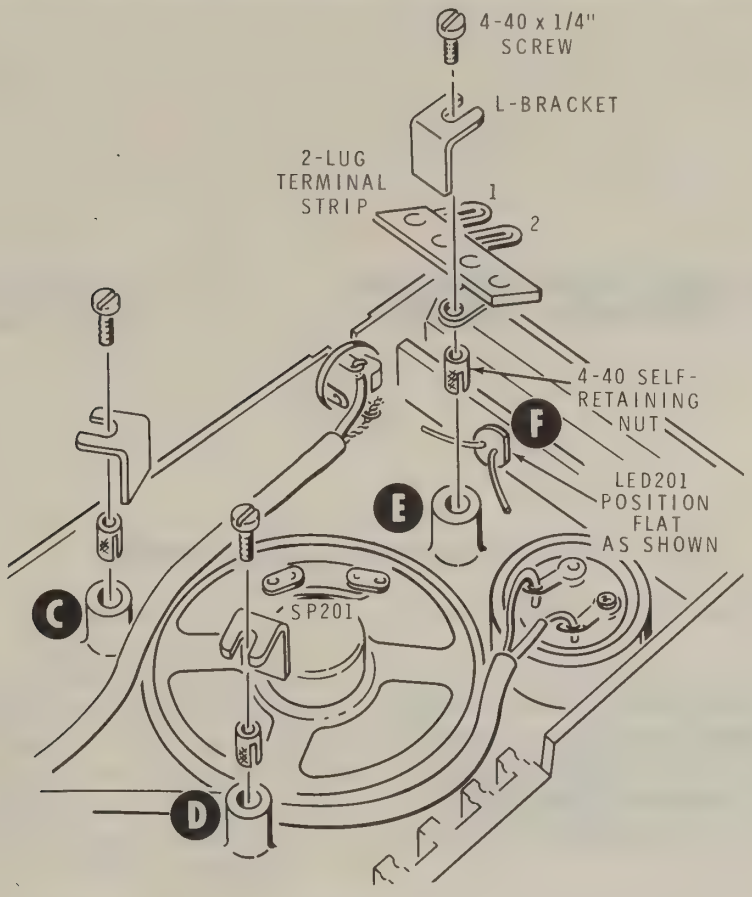
( ) Install PCB connectors on only one end of the 2-wire cable.

CAUTION: When you solder to the speaker lugs in the following steps, be careful so that no solder drops on the speaker cone.

Connect the free end of the 2-wire yellow and green cable as follows:

( ) Yellow wire to speaker SP201 lug 1 (S-1).

( ) Green wire to speaker SP201 lug 2 (S-1).




**Detail 3-1G**

NOTE: Place a 3" x 4" piece of 1/8" thick corrugated cardboard, or similar material, under the grille while you install the self-retaining nuts in the following step. This will keep the grille from being damaged.

( ) Refer to Detail 3-1G and install a 4-40 self-retaining nut at E as shown. Position the nut with the slotted end down. Then, using the plastic handle of a screwdriver, carefully press the nut down into the boss until it is flush with the top of the boss.

( ) In the same manner, install a self-retaining nut in each of the remaining six bosses in the case top at A, B, C, D, G, and H.

( ) SP201: Mount the speaker with the lugs positioned as shown in Detail 3-1G. Use 4-40 x 1/4" screws and L-brackets at C and D. Position the coaxial cables between the respective boss and L-bracket. DO NOT tighten the screws yet.

( ) Install the prewired 2-lug terminal strip at E with a 4-40 x 1/4" screw and an L-bracket. Position the terminal strip as shown in the Detail.

Cut the LED lamp leads to the following lengths:

( ) Lead closer to the flat to 1/2".

( ) The other lead to 3/8".

( ) Install the LED lamp into hole F with the flat of the lamp positioned as shown in Detail 3-1G.

Solder the LED lamp leads to the 2-lug terminal strip lugs as follows:

( ) Lead closer to the flat to lug 2 (S-1).

( ) The other lead to lug 1 (S-1).

( ) Tighten the screws at C and D, then at E.

# BATTERY PACK TEST

NOTE: It is normal for a fully charged battery pack to measure 14 volts.

( ) Use a voltmeter to measure the voltage across the terminals on the battery pack. If the voltmeter indicates at least 12 volts, the battery pack is functioning properly; proceed to "~~Alignment~~ INITIAL TESTS." If it indicates less than 12 volts, complete the following steps.

1. Make sure each cell was installed correctly in the battery housing.

2. If the cells are installed correctly, use a voltmeter and test each cell. NOTE: You may leave the cells in the battery housing while you test the cells. If you connect the voltmeter according to the polarity marking on the cell, the voltmeter should read approximately 1.2 volts.

3. If the cell is dead, proceed as follows:

   A. Mark the dead cell. Then remove the dead cell and also a good cell from the battery housing.

   B. Temporarily solder a short red wire to the positive (+) tab and a short brown wire to the negative (–) tab of the dead battery cell.

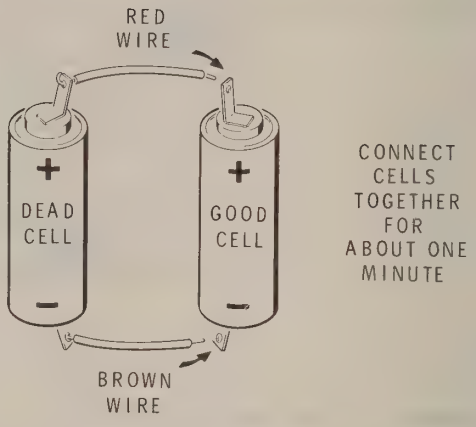



**Figure 1**

   C. Refer to Figure 1 and connect the dead cell in parallel (+ to +, and – to –) with a good cell for about one minute. Then disconnect the cells and remove the red and brown wires. If the cell that was dead will "take a charge," it should now read up-scale on the meter.

   D. If it does, reassemble the battery pack, and charge the battery.

   E. If the cell is still dead, procure a new cell for the battery pack and again charge the battery.

NOTE: If the batteries are not fully charged, you will not be able to obtain the proper results when you align your Transceiver.

# INITIAL TESTS

## RESISTANCE MEASUREMENTS

You will now use an ohmmeter to make resistance measurements on the main circuit board. This test will tell if a short circuit or open circuit exists, which might cause a problem when power is applied to the circuit board. If you cannot obtain the proper ohmmeter reading in the following steps, refer to the "In Case of Difficulty" section. DO NOT apply power to the circuit board until the difficulty has been corrected.

NOTE: Use a vacuum tube voltmeter (VTVM) or a volt-ohmmeter (VOM) to make the resistance checks in the following steps (solid-state ohmmeters do not furnish a voltage high enough to make the diodes conduct in the circuit being tested). Make sure you have the ohmmeter set correctly, since the range setting influences the meter reading when a diode is in the circuit.

To make this test, first touch the test leads of your ohmmeter together and vary the OHMS ADJUST control to obtain a "0" reading on the meter. If you get this reading in any of the resistance checks that follow, it will mean that there is a short circuit somewhere in the circuit you are checking.

In any of these resistance checks, a meter reading lower in value than the one shown in the chart might indicate a solder bridge across adjacent foils on the circuit board. A meter reading that is higher than the one shown might indicate a poor solder connection or a faulty or improperly installed component.

NOTE: The internal wiring of most ohmmeters is such that the positive terminal of the meter battery is connected to the positive (red) test lead and the negative battery terminal is connected to the negative (black) test lead. In some ohmmeters this wiring is reversed and erroneous readings will be obtained when you make the following measurements. Reverse the ohmmeter leads if the measurements do not check out correctly the first time.

( ) Set your ohmmeter to the RX100 range.

Refer to Pictorial 2-16 (in the "Illustration Booklet") for the following step.

( ) Turn the on/off switch (SW2) on.

616- 982-3296

IMPORTANT: The ohmmeter readings in the following chart were made with a Heathkit Model IM-18 VTVM, and are intended only to show whether short circuits or open circuits are present. Readings made with other ohmmeters (because of different measuring voltages and currents) may be considerably different.

Refer to Pictorial 2-16 (in the "Illustration Booklet") for the location of the test points given on the following chart.

Then connect your ohmmeter leads as directed and make the measurements shown on the chart.

If you do not obtain the proper ohmmeter readings, make sure the banded end of each of the following diodes is positioned correctly: Diodes D1 and D2 on the main circuit board and diodes D301, D302, D303, and D304 on the battery charger circuit board. Also look for solder bridges or foil bridges on both circuit boards and refer to "In Case of Difficulty" on Page 62.

| OHMMETER TEST POINTS | | RESISTANCE IN OHMS | CONDITION | A | B |
|---|---|---|---|---|---|
| COMMON LEAD | POSITIVE (+) LEAD | | | | |
| ( ) "–" connector on charger circuit board | "+" connector on charger circuit board | 800 – 1200 Ω | Rx/Tx button (SW1) out. | 920 | 910 |
| ( ) "+" connector on charger circuit board | "–" connector on charger circuit board | 400 – 800 Ω | Rx/Tx button (SW1) out. | 550 | 480 |
| ( ) "–" connector on charger circuit board | Switch SW1 lug 3 | 800 – 1200 Ω | Rx/Tx button (SW1) out. | 920 | 1180 |
| ( ) "–" connector on charger circuit board | Switch SW1 lug 2 | 200 – 400 Ω | Rx/Tx button (SW1) out. | 270 | 280 |
| ( ) "–" connector on charger circuit board | Switch SW1 lug 2 | 150 – 300 Ω | Rx/Tx button (SW1) in. | 230 | 240 |
| ( ) "–" connector on charger circuit board | Top lead of 47 Ω resistor, R21. (located near pin 16 of IC1) | 100 – 200 Ω | Rx/Tx button (SW1) out. | 120 | 122 |

# VOLTAGE CHECKS

Refer to Pictorial 3-2 (in the "Illustration Booklet") for the following steps.

IMPORTANT: In the following steps, we suggest that you keep the main circuit board away from any metallic surface, as this could accidentally short circuit the foils on the board. Therefore, place the main circuit board on a wooden table while you perform these steps.

( ) Position the main circuit board near the case top as shown.

Connect the four wires coming from the case top to the main circuit board as directed in the following steps. Push the PCB connector on the end of each wire onto the connector pin mounted on the circuit board.

( ) Green wire to 1.

( ) Yellow wire to 2.

( ) Blue wire to S.

( ) Violet wire to T.

( ) Turn the Transceiver VOLUME (VOL) control fully counterclockwise until it clicks ("off" position).

( ) Turn the SQUELCH (SQ) control fully counterclockwise.

( ) Turn the CHANNEL (CHAN) switch fully counterclockwise.

( ) Plug the connectors on the battery charger circuit board onto the matching connectors on the battery housing.

NOTES:

1. In the following steps you will need a vacuum tube voltmeter (VTVM) or a volt-ohmmeter (VOM).

2. The batteries must be fully charged before you perform the following voltage checks. Refer to the "Battery Charging" section for the proper battery charging procedure.

3. If you do not obtain the proper reading when you perform a step, turn the Transceiver off and refer to the boxed chart that follows. If you have a difficulty, DO NOT proceed until it has been corrected.

( ) Set your voltmeter to its +1.5 VDC range and connect the common meter lead to the negative battery connector.

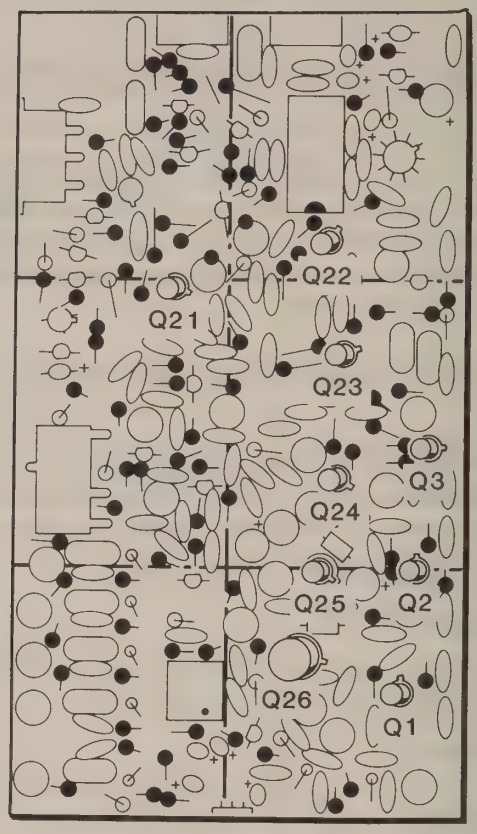



**Figure 2**

Refer to Figure 2 and connect the other meter lead to the metal case of each of the transistors as directed in the following chart. For each step, turn the Transceiver on. Check for the proper meter indication as shown in the chart. Then turn the Transceiver off.

| VOLTMETER TEST POINTS | | VOLTAGE IN VOLTS | POSSIBLE CAUSE OF TROUBLE |
|---|---|---|---|
| COMMON LEAD | POSITIVE (+) LEAD | | |
| ( ) "–" connector on charger circuit board | case of Q1 | .7 to 1.2 .84 - | Transistor Q1 defective. |
| ( ) "–" connector on charger circuit board | case of Q2 | .7 to 1.2 .70 - | Transistor Q2 defective. |
| ( ) "–" connector on charger circuit board | case of Q3 | .5 to 1.0 .39 | Transistor Q3 defective. |

In each of the following steps:

1. Set your voltmeter to the proper range. Refer to the Voltage column.

2. Connect the positive meter lead to the metal case of the transistor listed in that line.

3. Turn the Transceiver on and press the PTT button only long enough to check for the proper meter indication, as shown in the chart. Then turn the Transceiver off.

| VOLTMETER TEST POINTS | | VOLTAGE IN VOLTS | POSSIBLE CAUSE OF TROUBLE |
|---|---|---|---|
| COMMON LEAD | POSITIVE (+) LEAD | | |
| ( ) "–" connector on charger circuit board | case of Q21 | .8 to 1.2<br>1.24 | 1. Switch SW1.<br>2. Q21 or associated components improperly soldered. |
| ( ) "–" connector on charger circuit board | case of Q22 | 12 to 14<br>12.0 | 1. Switch SW1.<br>2. Q22 or associated components improperly soldered. |
| ( ) "–" connector on charger circuit board | case of Q23 | 12 to 14 | 1. Switch SW1.<br>2. Q23 or associated components improperly soldered. |
| ( ) "–" connector on charger circuit board | case of Q24 | 12 to 14 | 1. Switch SW1.<br>2. Q24 or associated components improperly soldered. |
| ( ) "–" connector on charger circuit board | case of Q25 | 12 to 14 | 1. Switch SW1.<br>2. Q25 or associated component improperly soldered. |
| ( ) "–" connector on charger circuit board | case of Q26 | 12 to 14 | 1. Switch SW1.<br>2. Q26 or associated components improperly soldered. |

( ) Turn the Transceiver off.

# ALIGNMENT

You can completely align your Transceiver using only a single RF detector and a voltmeter. If you have access to a signal generator that is accurate at the operating frequency, you can also use it to align the receiver portion of your Transceiver.

## COIL CORES

During the alignment procedure you will use the alignment tool to adjust a number of coil cores.

1. If a coil core will turn but offers resistance, put a very small amount of vaseline on the inside of the coil form next to the core and then back the core out. Its threads will pick up the lubrication and the core will turn more easily.

2. If you wedge the core down against the circuit board and cannot back it out, you will have to unsolder the coil form pins so the coil form can move away from the board slightly to relieve the pressure. "Solder wick" is very useful when performing any unsoldering operation.

## ALIGNMENT PREPARATION

Refer to Figure 3 for the following steps.

( ) Locate the 5-lug terminal strip you laid aside earlier.

In the following steps you will prepare an RF detector circuit. Connect each component and wire to the 5-lug terminal strip as directed in the steps.

( ) R401: Connect a 100 kΩ (brown-black-yellow) resistor between lug 2 (NS) and lug 4 (NS).

( ) D401: Connect the lead at the banded end of a 1N191 diode (#56-26, brown-white-brown) to lug 4 (S-2). Connect the other lead to lug 3 (NS).

NOTE: In the following step, bend over the capacitor lead connected to lug 2 as shown. DO NOT cut this lead off.

( ) C402: Connect a .01 μF (103) ceramic capacitor between lug 2 (S-3) and lug 3 (S-2). NOTE: When the capacitor lead passes through the lug, it counts as two leads in the solder instructions (S-2), one entering and one leaving the lug.

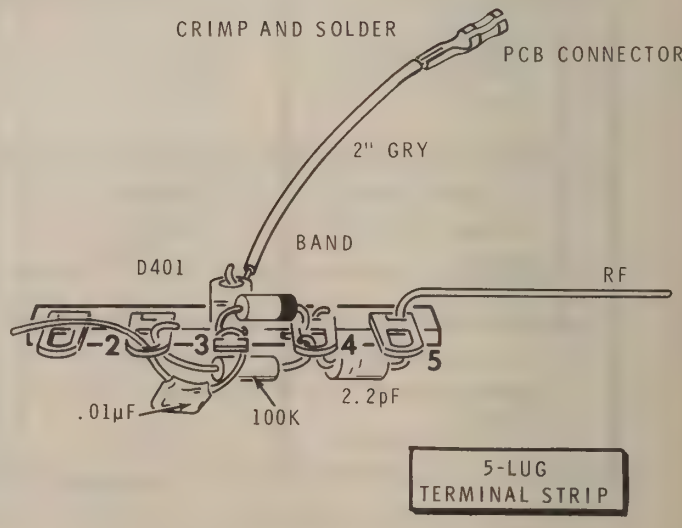



Figure 3

NOTE: In the following step bend over the capacitor lead connected to the lower hole of lug 5 as shown. DO NOT cut this lead off.

( ) C401: Connect a 2.2 pF (red-red-white) phenolic capacitor between the lower holes of lug 4 (S-1) and lug 5 (S-2). NOTE: When the capacitor lead passes through the lug, it counts as two leads in the solder instructions (S-2), one entering and one leaving the lug.

( ) Prepare a 2" gray wire from the wires that were cut off the 8-wire cable.

( ) Install a PCB connector on only one end of the 2" wire.

( ) Connect the free end of the 2" gray wire to the mounting lug of the terminal strip (S-1).

( ) Prepare a 4" red wire by removing 1/4" of insulation from each end. This will be called a "jumper wire."

Lay aside the RF detector and the prepared "jumper wire." They will be used later.

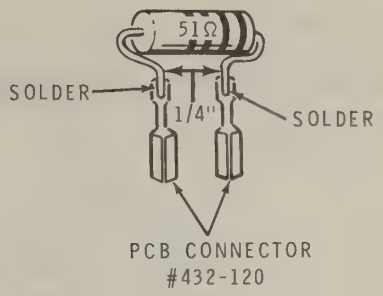



**Figure 4**

Refer to Figure 4 for the following steps.

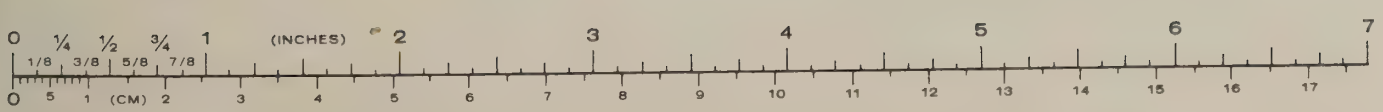
( ) Cut each lead of a 51 Ω, 1-watt resistor (green-brown-black) to 5/8".

( ) Solder a PCB connector (#432-120) to each lead. Then bend the leads down so they are parallel. This assembly forms a "dummy" load.

Refer to Pictorial 3-2 (in the "Illustration Booklet") for the following steps.

( ) Connect the 51 Ω dummy load to PCB connector pins P and N on the main circuit board.

( ) Temporarily solder together the free ends of the two leads coming from holes 1 and 2 within the outline of switch SW3.



# TRANSMITTER ALIGNMENT

The adjustments in this section and the "Receiver Alignment" section will be performed twice to obtain a satisfactory result. Go through all the steps in these two sections, the first time to obtain approximately the correct setting of the coil cores. The second time you go through these steps (after the main circuit board has been installed in the case bottom), you may have to readjust some of the coil cores slightly in order to achieve the proper result.

IMPORTANT: DO NOT ATTEMPT TO TRANSMIT WHILE THE BATTERY PACK IS BEING CHARGED.

NOTE: In the following steps you will need a vacuum tube voltmeter (VTVM) or a volt-ohmmeter (VOM) in addition to the RF detector and the "jumper wire."

If you do not see a meter reading when you are using the voltmeter in a step, check the voltage at the appropriate point against the voltage shown on the Schematic and in the "Voltage Chart."

Refer to Figure 5 (in the "Illustration Booklet") for the following steps.

( ) Refer to inset drawing #1 and turn the five netting capacitors, C49 and C51 through C54, to minimum capacity (rotor positioned as shown).

( ) Turn the DEVIATION ADJUST control (R84) to the position shown in inset drawing #2.

( ) Make sure the crystals in sockets Y2 and Y8 are installed firmly.

( ) Refer to the inset drawing #3 on Figure 5 and use the proper end of the alignment tool to rotate the core of each coil counterclockwise until the core is level with the top of the coil form.

IMPORTANT: Be sure that you perform each of the following steps in the order listed, and that all of the adjustments are made before you operate your Transceiver.

If you do not obtain the proper result when you perform a step, turn the Transceiver off and refer to the "Possible Cause Chart" that follows. These charts list the trouble and one or more possible causes of the trouble. If none of these difficulties listed is the cause of the malfunction, refer to the appropriate parts of the "Troubleshooting" section. If you have a difficulty, DO NOT proceed until it has been corrected.

( ) Rotate the core of each coil given below clockwise as follows:

| | | | |
|---|---|---|---|
| L7 | 1 turn | L13 | 2 turns |
| L8 | 3 turns | L14 | 1 turn |
| L9 | 4 turns | L15 | 6 turns |
| L11 | 4 turns | L18 | 2 turns |
| L12 | 2-1/2 turns | L22 | 3 turns |

NOTE: During the alignment it should not be necessary to rotate the core of any coil more than one turn in either direction from the preset position. However, if you think that a core has been adjusted too far, repeat the step. Then reset the coil core to the preset position listed and repeat the alignment step for that coil.

( ) Turn the Transceiver on by turning the VOLUME control clockwise until it clicks. The LED lamp should light.

**POSSIBLE CAUSE CHART**

1. LED lamp does not light.
   - A. The SQUELCH control is in the clockwise position.
   - B. Check the wiring of the 2-lug terminal strap.
   - C. LED defective.

NOTE: If you are using more than one channel, always align the transmitter on the channel nearest the center of the frequency spread you desire.

( ) Turn the Transceiver off.

( ) ( ) Temporarily disconnect the blue wire from connector pin "S" on the circuit board.

Connect the free end of the wires on the RF detector as follows:

( ) ( ) Gray wire to circuit board pin S.

( ) ( ) Temporarily solder the wire labeled "RF" to the top lead of a 47 kΩ (yellow-violet-orange) resistor at R11. See Figure 5.

( ) ( ) Wrap the remaining lead (of the .01 μF capacitor) a few turns around the tip of the voltmeter probe.

( ) ( ) Set your voltmeter to its lowest +DC range and connect the common meter lead to the negative battery connector.

( ) ( ) Turn the Transceiver on and adjust the VOLUME control for a comfortable noise level.

NOTE: Do not be concerned with any apparent oscillation or whistling sound in the receiver at this time.

( ) ( ) Adjust (rotate) the cores of coils L7, L8, and L9, in the sequence listed, for a maximum voltmeter reading. Use the proper end of the alignment tool. The voltmeter should read between 1.0 and 1.4 volts.

( ) ( ) Turn the Transceiver off.

( ) ( ) Unsolder and remove the RF detector lead from the 47 kΩ resistor.

( ) ( ) Remove the gray wire from circuit board pin S.

( ) ( ) Remove the other RF detector lead from the tip of the voltmeter probe. Instead, connect the voltmeter probe to TP2 (the top of a 10 Ω resistor).

( ) ( ) Turn the Transceiver on.

NOTE: DO NOT keep the transmitter keyed for more than 10 seconds at a time.

( ) ( ) Press the PTT button. The voltmeter should read at least .1 volt.

**POSSIBLE CAUSE CHART**

1. No meter indication.
   - A. Recheck the alignment of coils L7, L8, and L9.
   - B. Jumper wire is installed at circuit board connector pins J and K.
   - C. Check for voltages at transistors Q21, Q22, Q23, and Q24.

( ) ( ) Adjust the cores of coils L11, L12, L13, and L14, in the sequence listed, for a maximum voltmeter reading.

( ) ( ) Release the PTT button.

( ) ( ) Disconnect the voltmeter probe from TP2.

( ) ( ) Turn the Transceiver off.

Connect the free ends of the wires on the RF detector as follows:

( ) ( ) Solder the wire labeled "RF" to the dummy load wire at circuit board pin P.

( ) ( ) Gray wire to circuit board pin G.

( ) ( ) Wrap the remaining lead (of the .01 μF capacitor) a few turns around the tip of the voltmeter probe.

NOTE: In the following steps, set your voltmeter to the proper range to prevent the meter pointer from deflecting full scale as you make the adjustment.

( ) ( ) Turn the Transceiver on.

( ) ( ) Press the PTT button on your Transceiver.

( ) ( ) In the sequence listed, adjust (rotate) the cores of coils L15, L18, and L21 for a maximum meter reading.

IMPORTANT: You will perform the following three steps in order to keep the transmitted spurious frequencies at the lowest possible level.

( ) ( ) Adjust the core of coil L7 for a maximum meter reading.

( ) ( ) Adjust the core of coil L8 in the same manner.

( ) ( ) Adjust the core of coil L9 for a maximum meter reading.

( ) ( ) Turn the Transceiver off.

( ) ( ) Disconnect the voltmeter leads and the RF detector.

( ) ( ) Connect the blue wire to connector pin S on the circuit board.

NOTE: The second harmonic trap, C116 in series with L22, was preadjusted in a previous step to give satisfactory second harmonic attenuation. If you wish to adjust L22 for maximum second harmonic attenuation, you will need a grid dip oscillator or a spectrum analyzer. If you do not have either of these instruments, you may disregard the next three steps.

( ) ( ) Select the diode or the absorption mode of the grid dip oscillator.

( ) ( ) Turn the grid dip oscillator to a frequency just under 300 MHz (the second harmonic of the transmitted signal). When you tune the grid dip oscillator to that frequency, you will observe a "dip" in the reading on the instrument meter. Adjust coil L22 for a minimum meter indication on the grid dip oscillator.

( ) ( ) Turn the Transceiver off.

Proceed to "Receiver Alignment."

# RECEIVER ALIGNMENT

You can use either of two methods to align the receiver section of your Transceiver. If you will use a voltmeter as an indicator, perform the steps under "Alignment Without Instruments." If you have access to an FM signal generator which is accurate at your operating frequency, perform the steps under "Alignment With Instruments."

## Alignment Without Instruments

Refer to Figure 5 (in the "Illustration Booklet") for the following steps.

( ) Prepare a U-shaped jumper wire from a cut-off resistor lead.

( ) ( ) Temporarily install this jumper wire between wire sockets J and K on the circuit board.

( ) ( ) Temporarily solder one end of the prepared 4" red "jumper wire" to lug 3 of switch SW1 (the PTT switch). Insert the other end into connector pin L on the main circuit board.

( ) ( ) Turn the Transceiver on and carefully remove the end of the 4-inch jumper wire installed in wire socket L. The noise level from the speaker should increase.

( ) ( ) Connect the voltmeter probe to TP1 (the top lead of a 4700 Ω resistor).

( ) ( ) Connect the free end of the 4-inch "jumper wire" to wire socket L. The voltage at TP1 should increase.

( ) ( ) Rotate the core of each of the following coils clockwise as follows:

| | |
|---|---|
| L1 | 3 turns |
| L2 | 2-1/2 turns |
| L3 | 2-1/2 turns |
| L4 | 2 turns |
| L5 | 5 turns |

NOTE: In the following step, coil L5 will tune very broadly.

( ) ( ) In the sequence listed, adjust (rotate) the cores of coils L5, L4, L3, L2, and L1 for a maximum voltmeter reading.

( ) ( ) Turn the Transceiver off.

( ) ( ) Remove and discard the short wire installed between wire sockets J and K.

( ) ( ) Unsolder and discard the 4" red wire connected between lug 3 of the PTT switch (SW2) and wire socket L.

NOTE: In order to further improve the sensitivity of the receiver section, either an on-the-air signal or an FM signal generator must be used.

( ) ( ) Connect the voltmeter probe to TP1.

( ) ( ) With a signal of the proper frequency present, adjust the cores of coils L5, L4, L3, L2, and L1 in the sequence listed for a maximum voltmeter reading.

Proceed to "Circuit Board Installation."

## Alignment With Instruments

This procedure requires the use of the following instruments, which must be capable of accurate readings at the operating frequency:

FM signal generator with output meter.

VTVM or VOM.

( ) ( ) Turn the Transceiver on and adjust the VOLUME control for a comfortable noise level.

Refer to Figure 5 (in the "Illustration Booklet") for the following steps.

( ) ( ) Rotate the core of each of the following coils clockwise as follows:

| | |
|---|---|
| L1 | 3 turns |
| L2 | 2-1/2 turns |
| L3 | 2-3/4 turns |
| L4 | 2-1/2 turns |
| L5 | 6 turns |

( ) ( ) Set your voltmeter to its +1.5 VDC range. Connect the common meter lead to the negative battery connector and connect the other lead to TP1 (the top lead of a 4700 Ω resistor).

Connect the FM signal generator cable to the circuit board connector pins as follows:

( ) ( ) Shield lead to N.

( ) ( ) Other lead to P.

( ) ( ) Set the generator for a modulated output of 1000 μV at the operating frequency. The voltmeter should show an indication.

( ) ( ) Adjust the signal generator output to give a voltmeter reading of about .75 volt.

NOTE: As alignment progresses, reduce the output of the signal generator as necessary to maintain a voltmeter reading between .75 and 1.0 volt.

( ) ( ) Adjust the cores of coils L3, L2, and L1 (in the order listed) for maximum meter reading.

( ) ( ) Repeat the last step several times until you get no further increase in the meter reading. NOTE: If you intend to cover a wide segment of the 2-meter band, such as 1.5 to 2.0 MHz, adjust these coils as follows:

L1 at the middle frequency.
L2 at the lowest frequency.
L3 at the highest frequency.

( ) ( ) Adjust the cores of coils L4 and L5 for minimum distortion.

( ) ( ) Turn the Transceiver off.

( ) ( ) Disconnect all test equipment.

Proceed to "Circuit Board Installation."

# CIRCUIT BOARD INSTALLATION

Refer to Pictorial 4-1 (in the "Illustration Booklet") for the following steps.

(X)(X) Install a self-retaining nut in each of the three short bosses inside the case bottom. Position each nut with the slotted end down. Then, using the plastic handle of a screwdriver, carefully press each nut down into the boss until it is flush with the top of the boss.

(X)(X) Peel off the backing paper from a 2-1/8" x 3" piece of insulating paper. Then press the paper into place inside the case bottom at the location shown.

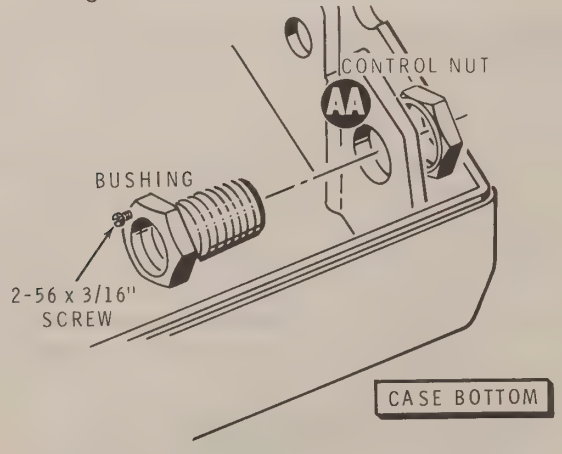
(X)(X) Cut the following lengths of insulating paper from the 3/8" wide piece left over:

1/2"
1"
1-1/2"

(X)(X) Peel off the backing paper from each of the three pieces of insulating paper. Then press each paper into place inside the case bottom at the location shown.

(X)(X) Locate the bushing.

(X)(X) Start a 2-56 x 3/16" screw in the tapped hole in the bushing.




Detail 4-1A

(X) Refer to Detail 4-1A and install the bushing in hole AA. Use a control nut. Position the bushing with the screw as shown before you tighten the nut.

(X) Tighten the screw in the bushing; then back the screw out three turns.

( ) Disconnect the four wires coming from the case top and previously connected to the circuit board connector pins.

( ) Unsolder the ends of the two leads coming from holes 1 and 2 within the outline of switch SW3.

Refer to Pictorial 4-2 (in the "Illustration Booklet") for the following steps.

( ) Position the case halves as shown in the Pictorial.

( ) Locate the main circuit board and install it in the case bottom by inserting the shafts of the two controls partly through holes R26 and R29/SW2.

( ) Refer to inset drawing #1 on Pictorial 4-2 and use a pair of long-nose pliers to install a 1/4" nut on each of the two control shafts. Then start the nut on the bushing of each control. Push the circuit board towards the front. Do not tighten the nuts yet.

( ) SW201: Insert the shaft of the switch only far enough through hole SW201 to slip a 1/4" nut over it. Then line up the flat on the bushing of the switch with the flat in the hole, and start the nut on the bushing. Tighten the nut securely.

( ) SW3: Refer to inset drawing #2 on Pictorial 4-2 and install a slide switch over SW3 on the circuit board outline, with the red dot on the switch positioned as shown. Be sure the leads previously installed at this location enter the switch lugs as shown. Also, make sure the flanges on each side of the switch rest inside the slot in the side of the case bottom. Solder each of the wires to the top row of lugs. Then cut off the excess lead lengths.

( ) Place a 4-40 x 1/4" screw through one of the three mounting holes in the circuit board. Then start the screw into the self-retaining nut.

( ) Similarly, place 4-40 x 1/4" screws in each of the two remaining holes in the circuit board. Then start the screws into the self-retaining nuts.

( ) Tighten the three 4-40 x 1/4" screws and secure the circuit board to the bosses.

( ) Tighten the nuts at R26 and R29/SW2.

NOTE: You will connect the wires coming from the case top to the main circuit board in the following steps. Push the PCB connector on the end of each wire onto the connector pin mounted on the circuit board.

( ) Green wire to 1.

( ) Yellow wire to 2.

( ) Blue wire to S.

( ) Violet wire to T.

( ) Be sure each of the wires is firmly connected.

( ) Push a knob on each of the two control shafts and the rotary switch shaft.

Repeat the steps with two checkoff spaces in both the "Transmitter Alignment" and the "Receiver Alignment" sections, starting on Page 51, before you continue with the following steps.

( ) Disconnect the 51 Ω dummy load from connector pins P and N.

Connect the free end of each cable coming from the case top to the main circuit board as follows:

( ) Shield lead of the short coaxial cable coming from jack J201 to R.

( ) Connect the inner lead of the short coaxial cable to the bushing at AA. Use the 2-56 x 3/16" screw to fasten the spade lug at the end of the lead to the bushing. Position the spade lug as shown before you tighten the screw.

( ) Inner lead of the long coaxial cable coming from jack J201 to P and shield lead to N.

( ) Inner lead of the cable coming from the microphone element to F and shield lead to G.

( ) Be sure each of the leads is firmly connected.

## FREQUENCY ADJUSTMENT

If you should ever determine that the transmitter is slightly off frequency on one or more channels, there are several methods for adjusting the transmitter to frequency. They are listed in the order of accuracy. Use only one of the methods.

1. Couple an accurate frequency counter loosely to the antenna. Adjust the appropriate netting capacitor (refer to the chart below) until the counter indicates the correct signal frequency.

CAUTION: As up to 10 volts may be present, and many counters have a 2-volt maximum input, use a suitable attenuator or the counter may be damaged. Consult the instruction book for your counter.

2. Use the facilities of a commercial two-way radio shop.

3. Use a receiver which has a metered discriminator and is of known frequency. Tune the receiver to the signal frequency and adjust the netting capacitor for an on-frequency indication.

4. Adjust the netting capacitor for acceptable modulation quality as judged by other amateur operators.

| CHANNEL SWITCH POSITION | CRYSTAL | NETTING CAPACITOR |
|---|---|---|
| 1 | Y6 | C54 |
| 2 | Y5 | C53 |
| 3 | Y4 | C52 |
| 4 | Y3 | C51 |
| 5 | Y2 | C49 |

# DEVIATION ADJUSTMENT

If a deviation monitor meter is available, adjust the DEVIATION ADJUST control (R85) for 4.5 to 5 kHz of FM deviation. A good way to accomplish this is to whistle a steady tone into the microphone.

If a deviation monitor meter is not available, use on-the-air checks with other amateur operators. Check with three or four stations to get a consensus of opinion on the recaptured audio in their receivers. Then adjust the DEVIATION ADJUST control until they say your deviation is correct.

NOTE: If the station with which you are checking has an old, surplus, commercial piece of equipment, it may have been designed to receive 15 kHz FM deviation signals. In this case, you may get a report of low level recaptured audio. Attempts to increase the deviation for this type of receiver will cause phase distortion or may even close the squelch on narrow bandwidth receivers designed for 5 kHz FM deviation signals.

This completes the alignment of your Transceiver. Proceed to the "Final Assembly" section.

# FINAL ASSEMBLY

Refer to Pictorial 5-1 for the following steps.

( ) Cut two pieces of foam tape; one 1/4" long and the other 3/8" long.

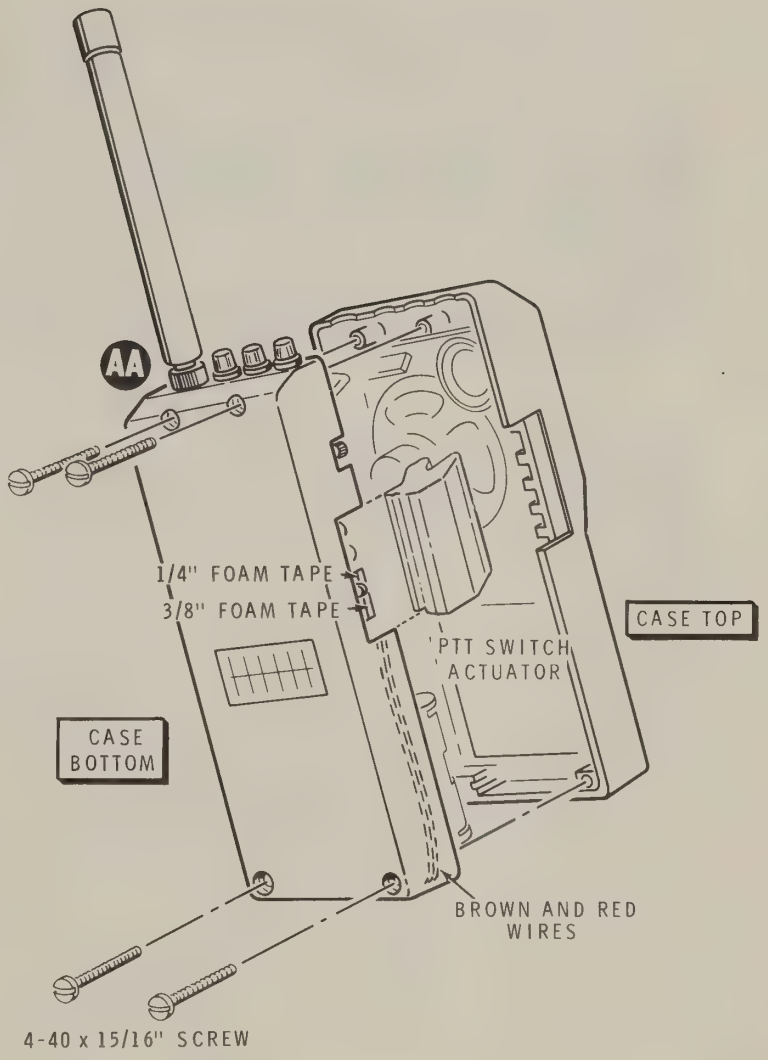
( ) Peel the paper backing from one piece at a time and press each piece against the PTT switch on each side of the switch button as shown.

( ) Install the battery pack with the charger board by sliding the circuit board into the slots inside the case bottom. Make sure the socket on the board is facing the slot in the case bottom. Position the red and the brown wires from the charger circuit board down between the battery housing and the side of the case bottom.

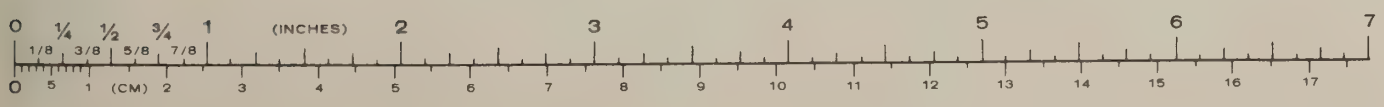
( ) Place the PTT switch actuator over the PTT switch and against the cutout in the side of the case bottom as shown. Then place the case top over the case bottom as shown. Be sure that the top is seated properly on the case bottom and that no wires or cables are being pinched; then secure the case top to the case bottom with four 4-40 x 15/16" screws.

( ) Start a round control nut on the bushing at AA. Tighten the nut.

( ) Install the antenna by starting it into the bushing at AA. Fasten the antenna securely.




PICTORIAL 5-1



Refer to Pictorial 5-2 for the following steps.

IMPORTANT: In the following steps, be sure you position each label as shown in the Pictorial before you press it in place.

( ) Peel off the protective backing paper from the function label (#390-1165). Then press the label in place in the recessed area of the case bottom.

( ) Peel off the protective backing paper from the decorative label (#390-1166). Then press the smaller part of the label in place in the upper part of the case top as shown.

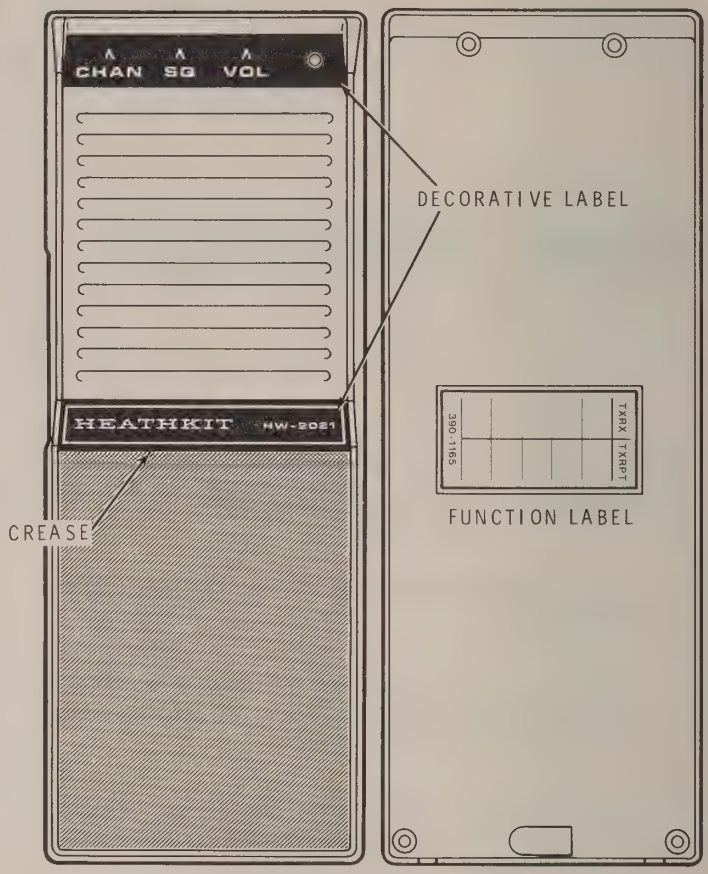
( ) Use a screwdriver blade to make a crease in the larger part of the label, at the location shown, while you press the label in place.

NOTE: The blue and white label that will be installed in the following steps shows the Model number and Production Series number of your kit. Refer to these numbers in any communications with the Heath Company.

( ) Carefully peel away the paper backing from the blue and white label. Then press the label onto the cover of this Manual.

This completes the Step-by-Step Assembly.

Proceed to the "Operation" section.




PICTORIAL 5-2

# OPERATION

Refer to Figure 6 (in the "Illustration Booklet") for the location and functions of switch, controls, and connections described in this section of the Manual.

## VOLUME Control

The VOLUME (VOL) control is used to adjust the sound output from the speaker to the desired listening level. It also turns the Transceiver power off in the full counterclockwise position.

## SQUELCH Control

To adjust the SQUELCH (SQ) control, first turn it fully counterclockwise. Turn the Transceiver on and set the VOLUME control so you hear background noise at average volume. Then turn the SQUELCH control knob clockwise until the noise just disappears. Setting the SQUELCH control further clockwise requires a stronger received signal to break the squelch.

## CHANNEL Selector Switch

The CHANNEL (CHAN) selector switch selects any one of five crystals. A crystal must be plugged into one of the sockets for channels 1 through 4 before any of these channels can be used. You will need a crystal for each frequency you intend to use. (This unit uses the same crystal for receive and transmit.) NOTE: You may order a crystal certificate, Model HWA-2021-4, from the Heath Company for each crystal.

## OFFSET Switch

The OFFSET switch has two positions. Using the crystals supplied with this kit will allow you to operate this Transceiver on one receive frequency and either one of two transmit frequencies. With the red dot on the switch not showing, the receive and the transmit frequency is the same (146.94 MHz). However, with the red dot showing, the transmit frequency is 600 kHz lower than the receive frequency. (146.94 MHz on receive and 146.34 on transmit.) NOTE: The offset crystal, Y7, may be changed to provide an alternate transmitter offset frequency. Refer to "Offset Oscillator Crystals" on Page 61 for information on how to calculate the required crystal frequency.

### ANTENNA Jack

An external antenna, fed with 50 ohms cable, may be used with this Transceiver. A plug that mates with the antenna jack is supplied with this kit. When you use an external antenna, the "built-in" antenna is disconnected from the Transceiver.

### LED (Light Emitting Diode)

The LED on the front of the Transceiver serves the following functions:

A. When the audio is "squelched," the LED will blink --, indicating that the battery-saver circuit is operating.

B. When a signal is received (or the squelch is broken), the LED will light. This indicates that the battery-saver circuit is inoperative; thus, the audio is "unsquelched."

C. Battery condition indicator. If the LED does not light at all, the battery pack voltage is probably too low. The battery pack now needs to be recharged.

## BATTERY CHARGING

The battery charger furnished with this kit supplies about 60 mA of current to the battery pack when it is being charged. The charger limits the current to a safe value so the batteries can never be overcharged.

If you desire to charge the batteries from another DC source, such as an automobile battery, you must be very careful so you do not overcharge them. The charge rate should be between 50 and 80 mA. The DC voltage may be applied across the two outside terminals of the 4-pin socket mounted on the battery charger circuit board. NOTE: You do not have to be concerned with the polarity of the voltage applied to the socket because of the diode bridge isolation.

Under normal operation the batteries will last 10 hours on a full charge. Charge the batteries from 14 to 24 hours.

The charger may be connected to the Transceiver in the receive mode only if the Transceiver is turned on. NEVER TRANSMIT WITH THE CHARGER PLUGGED IN. The charger will cause hum on the transmitted signal.

# ORDERING CRYSTALS

15.1377
-10.7000

Crystals, in addition to those furnished, should be ordered through normal crystal suppliers. You may order a crystal certificate (for local oscillator crystals only), Model HWA-2021-4, from the Heath Company for each crystal. Note that the following specifications differ for local oscillator and offset oscillator crystals.

## Local Oscillator Crystals

| | |
|---|---|
| Crystal frequency (operates on fundamental frequency at parallel resonance) | $= \frac{\text{Operating frequency (MHz)} - 10.7 \text{ MHz.}}{9}$ |
| Tolerance at 25°C | = .0025% or better. |
| Load capacity | = 32 pF. |
| Effective resistance | = 40 Ω max. (–30°C to +60°C). |
| Holder* | = HC - 25U. |

## Offset Oscillator Crystals

| | |
|---|---|
| Crystal frequency (operates on fundamental frequency at parallel resonance) | =10.7 MHz - offset frequency in kHz (transmitter below the receiver frequency) OR =10.7 MHz + offset frequency in kHz (transmitter above the receiver frequency) |
| Tolerance at 25°C | = .0025% or better |
| Load capacity | = 32 pF |
| Effective resistance | = 40 Ω max. (–30°C to +60°C). |
| Holder* | = HC - 25U. |
| *Holder pin size | = .040" dia. |
| Holder pin spacing | = .192". |

# INSTALLATION

If additional transmitter power is needed, you may feed the signal from your Transceiver to a Heathkit, low-power (10 watts), 2-meter amplifier.

The Heathkit Auto Patch Encoder accessory was designed to be used with your Transceiver. The Encoder is attached to the top of the Transceiver and connections are easily made to the main circuit board. The Auto Patch Encoder is compatible with the telephone tone system.

A handsome carrying case of rich Naugahyde® is available as an accessory for your Transceiver.

# IN CASE OF DIFFICULTY

The first part of this section of the manual, titled "Visual Tests," describes what to do about the difficulties that may occur right after your unit is assembled.

If the "Visual Tests" fail to clear up the problems, or if difficulties occur after your unit has been in use for some time, refer to thy "Troubleshooting Charts."

The last part, titled "Checking Transistors and Diodes," tells you how to check these components.

## VISUAL TESTS

1. Recheck the wiring. Trace each lead with a colored pencil on the Pictorial as you check it. It is frequently helpful to have a friend check your work. Someone who is not familiar with the unit may notice something consistently overlooked by the kit builder.

2. About 90% of the kits that are returned to the Heath Company for service do not function properly due to poor connections and soldering. Therefore, you can eliminate many troubles by reheating all connections to make sure they are soldered as described in the "Soldering" section of the "Kit Builders Guide."

3. Closely examine each circuit board foil in a good light to see that no solder bridges exist between adjacent connections. If available, use a magnifying glass for this purpose. Remove any solder bridges by holding a clean, hot soldering iron tip between the two points that are bridged until the excess solder flows down onto the tip. Compare your foil pattern against the "X-Ray Views" on Page 72.

4. Be sure each transistor is in its proper location (correct part number and/or type number). Be sure that each transistor lead is in the proper hole.

5. Be sure the correct diode is installed at each diode location, and that the banded end is positioned up.

6. Check each capacitor value. Be sure that a capacitor of correct value is installed at each capacitor location. Check each tantalum capacitor to be sure the lead near the positive (+) marking is at the correct position.

7. Check each resistor value carefully. Be sure in each step that the proper part has been wired into the circuit, as shown in the Pictorial Diagrams. It would be easy, for example, to install a 47 kΩ (yellow-violet-orange) resistor where a 4700 Ω (yellow-violet-red) resistor should have been installed.

8. Be sure all wires and leads connected to the circuit boards have been trimmed as close as possible to the circuit board foils.

9. Try to analyze the symptoms of any problem you may have before starting any troubleshooting procedure. A review of the "Circuit Description" may also help you determine where the trouble is.

$$\frac{15.1377}{1} = \frac{\text{Freq} - 10.7\text{MHz}}{9}$$

$$\text{Freq} - 10.7 = 15.1377 \times 9$$

$$\begin{array}{r} 15.1377 \\ \times\ 9 \\ \hline 136.2393 \\ +\ 10.7000 \\ \hline 146.9393 \end{array}$$

$$\text{Freq} = 146.94$$

144 - 148

$$\begin{array}{r} 146.94 \\ -\ 10.7 \\ \hline \end{array}$$

$$9\overline{)\,136.240}\,(\,15.137$$

$$\begin{array}{r} 9 \\ \hline 46 \\ 45 \\ \hline 12 \\ 9 \\ \hline 34 \\ 27 \\ \hline 70 \\ 63 \end{array}$$

If you still cannot locate the trouble after completing the "Visual Tests," and a voltmeter is available, check voltage readings against those shown on the "Schematic Diagram" and in the "Circuit Board Voltage Chart." Read the "Precautions for Troubleshooting" before you make any measurements. NOTE: All voltage readings were taken with a high input impedance voltmeter. Voltages may vary as much as ±20%.

NOTE: In an extreme case where you are unable to resolve a difficulty, refer to the "Customer Service" information inside the rear corner of the Manual. Your Warranty is located inside the front cover.

## PRECAUTIONS FOR TROUBLESHOOTING

WARNING: Be very careful when you measure voltages so you do not damage circuit board components.

1. Be sure you do not short any adjacent foils when you make voltage measurements. If the probe should slip, for example, and short together two adjacent connections, it is very likely to damage the diodes or transistors.

2. Be especially careful when you test any circuit that contains a transistor. Although these components have an almost unlimited life when used properly, they are much more vulnerable to damage from excessive voltage or current than many other parts.

# TROUBLESHOOTING CHARTS

The following chart lists the "Condition" and the "Possible Cause" of a number of malfunctions. If a particular part is mentioned as a possible cause, check that part to see if it is incorrectly wired or installed improperly. Also check to see if an improper part was installed at that location. It is also possible, on rare occasions, for a part to be faulty.

## RECEIVER PROBLEMS

| CONDITION | POSSIBLE CAUSE |
|---|---|
| No sound from receiver. | 1. No supply voltage.<br>2. Transistors Q12 or Q14. |
| No receiver audio output with diode D8 temporarily removed. | 1. Integrated circuit IC2 incorrectly installed or defective.<br>2. Capacitor C41 backwards.<br>3. Speaker wires improperly connected to circuit board.<br>4. Speaker defective. |
| No receiver audio output. With the Squelch control fully counterclockwise, no hum is heard when pin 1 of IC2 is touched with a hand-held wire. | 1. Transistors Q5, Q6, Q7, Q8, or Q9 incorrectly installed or defective.<br>2. Diodes D8 or D9 incorrectly installed or defective.<br>3. Integrated circuit IC2 defective. |

| CONDITION | POSSIBLE CAUSE |
|---|---|
| Squelch control inoperative, noise low. | 1. Transistor Q4.<br>2. Transistors Q15, Q16, Q17, or Q18 and associated circuitry.<br>3. Integrated circuit IC1. |
| Receiver audio distorted. | 1. Bandpass filters FL1 or FL2.<br>2. Crystal Y1.<br>3. Capacitor C49, C51, C52, C53, or C54 misadjusted. |
| No audio output. Full level noise, Squelch control OK. | 1. Transistors Q1, Q2, Q3, Q15, Q16, Q17, or Q18.<br>2. Receive/transmit crystal not selected.<br>3. Diodes D3 through D7 installed backwards or defective.<br>4. Misaligned coils: L1, L2, L3, L7, L8, or L9.<br>5. Coils interchanged. See Page 77. |
| No receiver quieting during alignment, full level noise, Squelch control OK. | 1. Transistors Q15, Q16, Q17, or Q18 and associated circuitry.<br>2. Q3 and associated circuitry.<br>3. Switch SW2 in the wrong position during alignment. |

**SQUELCH – Perform the following checks in sequence.**

| CONDITION | POSSIBLE CAUSE |
|---|---|
| Audio output normal, Volume control action normal, Squelch control inoperative. | 1. Turn Squelch control fully clockwise.<br>2. Check collector voltage of Q5 for less than 1.0 VDC. If much higher, replace Q5.<br>NOTE: If voltage at TP1 is much higher than .5 VDC with no input signal, instead replace IC1. |
| Check Q6 | 1. Check collector voltage of Q6 for about 8.0 VDC. If much lower replace Q6. |

## SQUELCH (cont'd.)

| CONDITION | POSSIBLE CAUSE |
|---|---|
| Check Q7 | 1. Check collector voltage of Q7 for about .8 VDC. If much higher replace Q7. |
| Check Q9 | 1. Check collector voltage of Q9 for about 5.0 VDC. If much lower replace Q9. |
| Check Q8 | 1. Check collector voltage of Q8 for about .1 VDC. If much higher replace Q8. |

## RECEIVER AND TRANSMITTER PROBLEMS

| CONDITION | POSSIBLE CAUSE |
|---|---|
| LED lamp does not light. | 1. Zener diode ZD201.<br>2. Violet and blue wires to connector pins S and T interchanged.<br>3. Transistors Q11 through Q14 or diode D13 incorrectly installed or defective. |
| NOTE: Perform the following ten checks in the order listed. (Refer to the Voltage Chart on Page 73.) | |
| 1. No RF voltage at emitter (E) of transistor Q15. | 1. Crystal not correctly selected.<br>2. Transistor Q15.<br>3. Diodes D3 through D7 installed backwards or defective. |
| 2. No RF voltage at collector (C) of transistor Q16. RF present at E of Q15. | 1. Transistor Q16.<br>2. Coil L7 misadjusted. |
| 3. No RF voltage at collector (C) of transistor Q17. RF present at C of Q16. | 1. Transistor Q17.<br>2. Coil L8 misadjusted. |
| 4. No RF voltage at collector (C) of transistor Q18. RF present at C of Q17. | 1. Transistor Q18.<br>2. Coil L9 misadjusted. |

## TRANSMITTER PROBLEMS

| CONDITION | POSSIBLE CAUSE |
|---|---|
| 5. No RF voltage at source (S) of transistor Q20. | 1. Crystal not correctly selected.<br>2. Transistor Q20. |
| 6. No RF voltage at drain (D) of transistor Q21. RF present at S of Q20 and C of Q18. | 1. Transistor Q21.<br>2. Coil L11 misadjusted. |
| 7. No RF voltage at collector (C) of transistor Q22. RF present at D of Q21. | 1. Transistor Q22.<br>2. Coils L12 or L13 misadjusted. |
| 8. No RF voltage at collector (C) of transistor Q23. RF present at C of Q22. | 1. Transistor Q23.<br>2. Coil L14 misadjusted. |
| 9. No RF voltage at collector (C) of transistor Q24. RF present at C of Q23. | 1. Transistor Q24.<br>2. Coil L15 misadjusted. |
| 10. No RF voltage at collector (C) of transistor Q25. RF present at C of Q24. | 1. Transistor Q25.<br>2. Coils L16 and L17 misadjusted. |
| No transmitter power output. | 1. Shorted coaxial cables at jack J201.<br>2. Transistor Q26.<br>3. Coils L18 or L21 misadjusted. |
| No modulation; output power OK. | 1. Microphone cable defective.<br>2. Transistor Q19.<br>3. Integrated circuit IC3.<br>4. Varactor diode VD1.<br>5. Microphone cable connected to wrong circuit board pins. |
| Modulation weak or distorted. | 1. Incorrect setting of Deviation Adjust control R85.<br>2. Varactor diode VD1.<br>3. Defective microphone.<br>4. Transistor Q19.<br>5. Integrated circuit IC3. |

## BATTERY CHARGER

| CONDITION | POSSIBLE CAUSE |
|---|---|
| No charging. | 1. Diodes D301,D302,D303, or D304 installed backwards or defective.<br>2. Wiring of transformer T301.<br>3. Charging cable. |

# CHECKING TRANSISTORS AND DIODES

## SILICON BIPOLAR TRANSISTOR CHECKING

To check a transistor accurately, you should use a transistor checker. However, if one is not available, you can use an ohmmeter to determine the general condition of any of the bipolar transistors in this kit. The ohmmeter used must have at least 1 volt DC at the probe tip to exceed the threshold of the diode junctions in the transistor being tested.

To check a transistor with an ohmmeter, proceed as follows. NOTE: Identify the transistor leads on the "Semiconductor Identification Charts" on Page 75.

1. Unsolder and remove the transistor from the circuit.
2. Set the ohmmeter to the RX1000 range.
3. Connect one of the ohmmeter test leads to the base (B) of the transistor. Touch the other meter lead to the emitter (E) and then to the collector (C). Both readings should be the same, but may be either high or low. If one reading is high and the other low, the transistor should be replaced.
4. Repeat Step 3 with the test leads reversed.

NOTE: In the unusual case when the readings are all low or all high, no matter which ohmmeter lead is connected to the base, the transistor should be replaced.

## MOSFET AND JFET CHECKING

Insulated gate type MOSFET's are used at Q1, Q2, and Q3 in the receiver section, and at Q21 in the transmitter section. JFET's are used at Q19 and Q20 in the transmitter section. Usually, any defect in these devices is found to be an internal short circuit between the source and the gate of the JFET (between the source and one of the gates of the MOSFET). These devices can be checked for serviceability by one of the two following methods.

### Method 1

1. Remove the device from the circuit.
2. Set your ohmmeter to the R X 10 K range.
3. Connect the common meter lead to the gate and the test probe to the source.
4. If the device is good, a reading near infinity will be obtained. If you do not get this reading, reverse the meter leads.
5. If you do not get a reading near infinity with the meter leads connected either way, the device should be replaced.

### Method 2

1. Remove the device from the circuit.
2. Set your ohmmeter to the R X 10 K range.
3. Connect the gate to the source.
4. Connect the common meter lead to the gate and source and connect the test probe to the drain.
5. The meter reading should be in the lower part of the meter scale.
6. If the reading is not in the lower part of the meter scale, the device should be replaced.

## DIODE CHECKING

To check a diode, unsolder one end from the circuit board, pull the lead up out of the circuit board hole, and proceed as follows:

1. Set the ohmmeter on the R X 1000 range.
2. Connect one of the ohmmeter test leads to the cathode (banded) end of the diode. Connect the other test lead to the other end of the diode. Note the reading. Then reverse the meter leads and take another reading. One reading should be high and the other low (at least 10:1). If both the readings are either low or high, the diode should be replaced.

# SPECIFICATIONS

## RECEIVER

| | |
|---|---|
| Sensitivity | @ 20 dB Quieting: .75 μV.<br>@ 12 dB SINAD*: .50 μV. |
| Squelch Threshold | .3 μV or less. |
| Audio Output | .5 watts at less than 10% THD. |
| Operating Frequency Stability | .005% or better. |
| Image Rejection | —45 dB or greater. |
| IF Frequency | 10.7 MHz. |
| Modulation Acceptance | ±7 kHz minimum. |

## TRANSMITTER

| | |
|---|---|
| Power Output | 1 watt minimum. |
| Stability | .005% or better. |
| Oscillator Frequency | Approximately 15 MHz. |
| Multiplier Factor | x 9. |
| Modulation | Frequency. |

$$*\text{SINAD} = \frac{\text{Signal + noise + distortion}}{\text{Noise + distortion}}$$

## GENERAL

| | |
|---|---|
| Speaker Impedance | 8 Ω. |
| Operating Frequency Range | 143.9 to 148.3 MHz (unit will meet specifications ±1 MHz from alignment frequency within this range). |
| Operating Temperature Range | +10° to +120°F (–12° to +47°C). |
| Operating Voltage | 12.5 VDC nominal. |
| Size (overall) | 9-1/4" high x 1-7/8" deep x 3-1/4" wide. (23.5 cm x 4.8 cm x 8.3 cm). |
| Weight (including batteries) | 2 lbs. (.9 kg). |

# CIRCUIT DESCRIPTION

A number series has been assigned to the circuit components mounted on the main circuit board, the case, the battery charger, and the RF detector. These series numbers are referred to throughout the various sections of this Manual to help you identify the parts and determine their locations. These part numbers are grouped as follows:

| | |
|---|---|
| 1-199 | Parts on the main circuit board. |
| 201-299 | Parts on the case. |
| 301-399 | Parts in the battery charger. |
| 401-499 | Parts on the RF detector. |

Refer to the Schematic Diagram while you read the "Circuit Description."

## CHANNEL SELECTION

The 5-position rotary switch, SW201, selects the desired receive channel. This is also the transmit channel when crystal Y7 (10.7 MHz) is selected by slide switch SW2. When crystal Y8 (10.1 MHz or 11.3 MHz) is selected, the Transceiver is set up for repeater operation. (The transmitted signal is 600 kHz lower than the received signal when Y8 is 10.1 MHz, and 600 kHz higher when Y8 is 11.3 MHz). Thus, five receive and ten transmit channels are possible. This description discusses one channel. All other channel selection circuits are similar.

When crystal Y2 is selected by switch SW201, the cathode of diode D3 is connected to ground. The anode of the diode is at a positive potential; therefore, the diode will conduct. This connects crystal Y2, and other components to the base of Q15 to complete the circuit of the local oscillator. Transistor Q15 and its associated components form a fundamental frequency oscillator operating in the region around 15 MHz.

## OSCILLATOR MULTIPLIERS

A signal from transistor Q15 is fed to the base of frequency tripler transistor Q16. The output circuit of Q16 is tuned to a frequency three times that of the local oscillator. Thus, the signal coupled to the base of transistor Q17 is approximately 45 MHz. The third harmonic frequency of this signal, about 135 MHz, is fed to the base of amplifier transistor Q18. The output frequency of this stage is exactly 10.7 MHz below that of the incoming receive signal. The signal from transistor Q18 is coupled to gate G2 of the receive mixer, Q3, and also to gate G1 of the transmit mixer, Q21.

## RECEIVER

A solid-state diode T/R switch isolates the input of the receiver from the transmitter. In the receive mode 10 volts is applied to the anode of diode D14, causing the diode to conduct, thus creating a low impedance path for signals being received by the antenna. This signal is coupled into gate G1 of the 1st RF amplifier, MOSFET* Q1, where it is amplified. The output of Q1 is fed to the 2nd RF amplifier, Q2.

The input to gate G2 of transistor Q3 is the amplified oscillator signal. The incoming signal and the amplified oscillator signal are mixed in Q3, and the output is coupled through a four-pole crystal filter which filters all frequencies except 10.7 MHz. The signal is further amplified and filtered by Q4, the first IF amplifier.

The 10.7 MHz IF signal is fed into IC1. This stage further amplifies the IF signal. The signal is coupled from pin 8 to the crystal quadrature detector where it is demodulated. The audio is routed inside IC1 to an internal amplifier. The output of this amplifier is taken from pin 6 of IC1, filtered, and applied across Volume control R29. From the wiper arm of the Volume control, the audio signal is fed to the input of IC2, the audio output amplifier.

*Metal Oxide Semiconductor Field Effect Transistor.

## SQUELCH AND BATTERY SAVER

The Squelch control voltage is at pin 13 of IC1. This point is also used as a test point (TP1) during receiver alignment. The Squelch control voltage is applied to the emitter (E) of DC amplifier Q5.

With no input signal to the receiver, Squelch control R26 may be set so Q5 is conducting. In this case the output of Q5 is low.

The output from the Schmitt trigger, consisting of transistors Q6, Q7, and associated circuitry, will be low. The output from DC amplifier Q9 will be high. This voltage is then applied to the base of the squelch gate using transistor Q8. The output of Q8 will be low and pin 8 of IC2 will be close to ground potential. This will cause IC2 to cut off and "squelch" its output.

When a signal is received at the antenna, the voltage at pin 13 of IC1 will increase, causing transistor Q5 to stop conducting. When the voltage at the base (B) of transistor Q6 reaches about 1.2 volts, Q6 will turn on rapidly. At the same time a pulse will appear at the output of Q7. The output of Q9 will be high and the output of Q8 will be high. Diode D8 will be back-biased, allowing IC2 to operate normal and "unsquelch" its output. The audio output, at pin 9 of IC2, is now routed to the speaker, SP201.

The other output from the Schmitt trigger is coupled through DC amplifiers Q9 and Q10 to gate the pulse oscillator, consisting of transistors Q11, Q12, and associated circuitry. When the audio is squelched, the voltage on the collector of Q10 is low. Transistors Q11 and Q12 produce a pulsed output voltage. Each pulse lasts about 20 ms. The R/C time constant is determined by resistor R45 and capacitor C39.

The output of the pulse oscillator is fed to the base of buffer amplifier Q13; then inverted to drive the switching transistor, Q14. Thus, the battery voltage present at the collector of transistor Q14 is "pulsed" to the receiver to conserve battery power when the audio is "squelched.

## TRANSMITTER

The audio signal from the microphone is coupled to the gate (G) of JFET (junction field-effect transistor) Q19. The signal is then fed to pin 2 of IC3, the input of the amplifier/limiter. At pin 6 of IC3, the square-wave output receives the proper amount of pre-emphasis. Also, at this point signals over 3000 Hz are greatly attenuated. Consequently, the signal that is coupled to modulator diode VD1 approximates a sine wave. The signal remains pre-emphasized until it reaches the audio circuits in the receiver.

NOTE: In the receiver, the low frequency audio signals are amplified more than the high frequency signals. Thus, the audio from the receiver is very similar to the audio going into the transmitter.

Modulator diode VD1 also receives the signal from the local oscillator circuit, where the Channel Selector switch supplies a ground to the selected crystal circuitry. Diode VD1 is a back-biased variable capacitance diode. The audio signal from the wiper arm of Deviation Adjust control R84 varies the capacitance of the diode junction of VD1 at an audio rate. Thus, a frequency modulated signal results.

From VD1 the frequency-modulated signal is multiplied in Q16 and Q17. It is then amplified in Q18 and fed to gate G1 of the transmit mixer, Q21. A signal from the offset oscillator, Q20, is fed to gate G2 of Q21. After this process, the original 15 MHz signal is converted to approximately 146 MHz at the output of Q21.

Amplifiers Q22, Q23, and Q24 amplify and filter the transmitter signal. TP2 is a point at which the output of the transmit pre-driver stages can be measured. The transmitter driver, Q25, applies about 50 milliwatts to the output stage, Q26.

Impedance matching at the output of Q26 — to the 50 ohms required at the antenna — is accomplished in the circuit consisting of C113, L21, C114, and C115. When the PTT switch is pressed, diode D15 will conduct and power is applied to the antenna. C116 and L22 form a series-resonant circuit (trap) for the second harmonic of the transmitter signal.

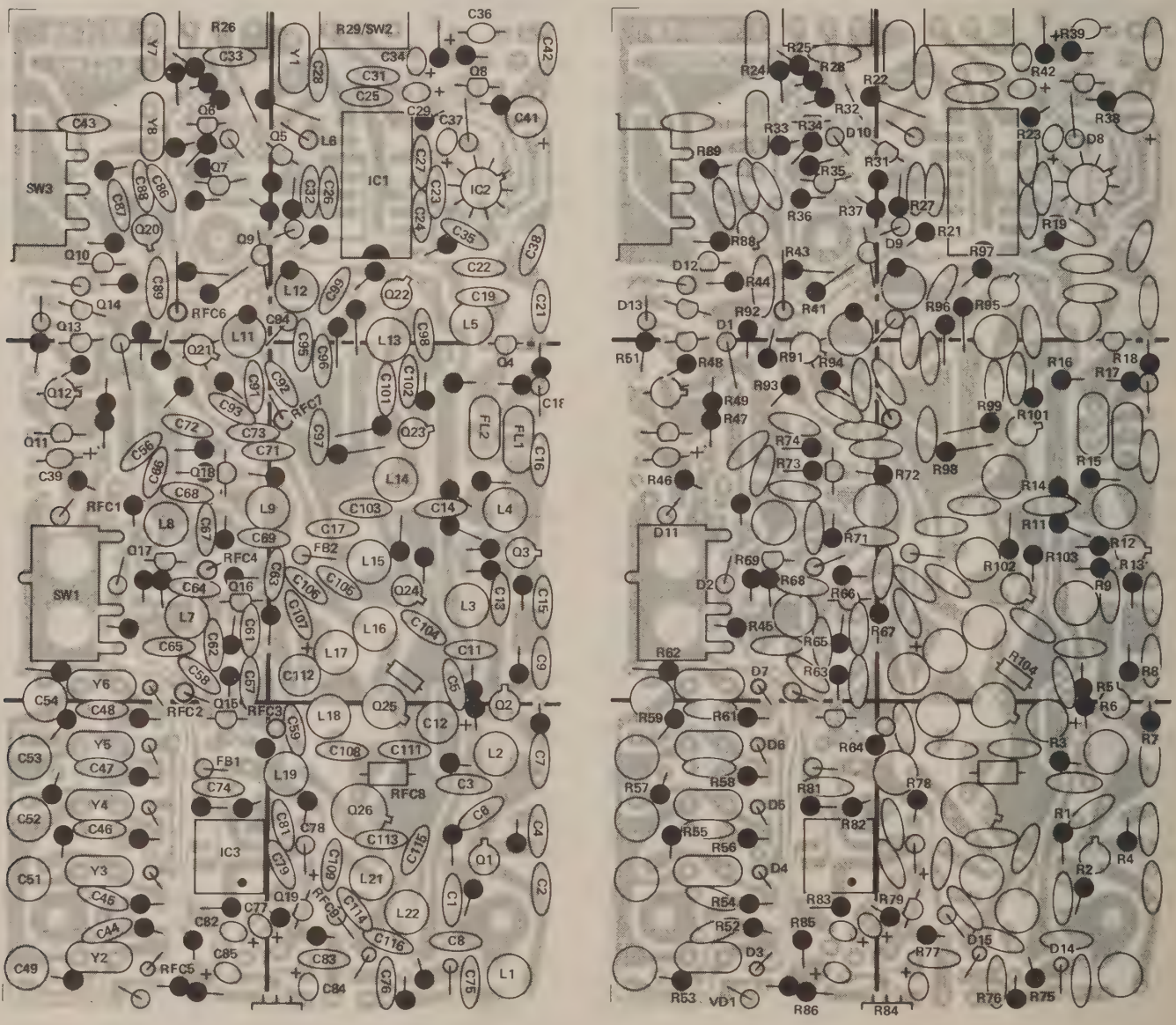
# CIRCUIT BOARD X-RAY VIEW

NOTE: To find the PART NUMBER of a component for the purpose of ordering a replacement part:

A. Find the circuit component number (R5, C3, etc.) on the "X-Ray View."

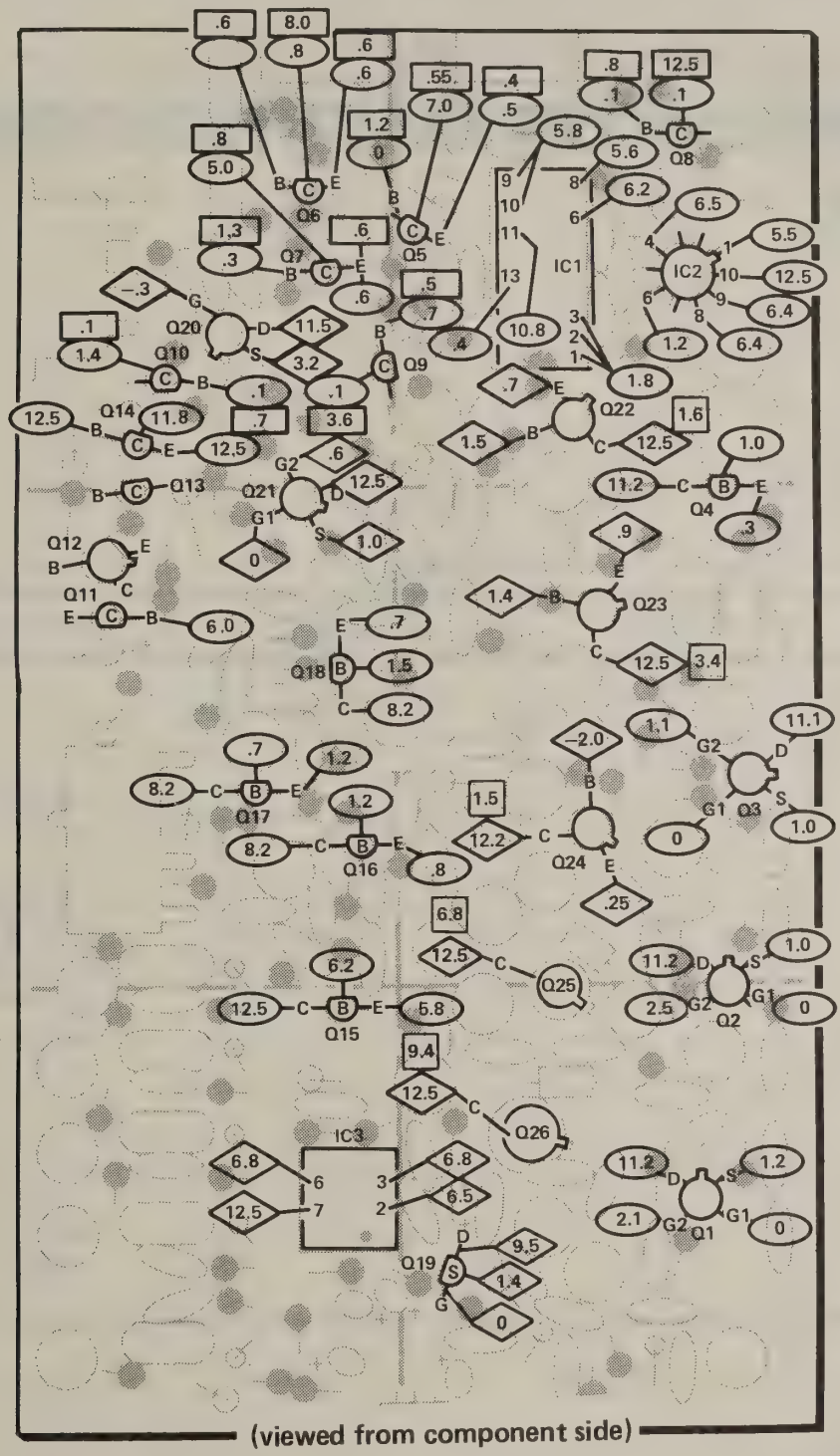
B. Locate this same number in the "Circuit Component Number" column of the "Parts List" in the front of this Manual.

C. Adjacent to the circuit component number, you will find the PART NUMBER and DESCRIPTION which must be supplied when you order a replacement part.




(viewed from component side)

# CIRCUIT BOARD VOLTAGE CHART




(viewed from component side)

**VOLTAGE CHART NOTES:**

DC VOLTAGES ( ±20%)

1. NO INPUT SIGNAL.
2. ANTENNA INSTALLED.
3. VOLUME CONTROL AT 9 O'CLOCK POSITION.
4. BATTERY VOLTAGE IS 12.5 VOLTS.

RECEIVER DC VOLTAGE WITH SQUELCH CONTROL FULLY COUNTERCLOCKWISE.

RECEIVER DC VOLTAGE WITH SQUELCH CONTROL FULLY CLOCKWISE.

TRANSMITTER DC VOLTAGE WITH PTT SWITCH PRESSED.

TRANSMITTER RF VOLTAGE WITH PTT SWITCH PRESSED (USE RF DETECTOR WITH VTVM) NOTE : THE COLLECTOR IS INTERNALLY CONNECTED TO THE CASE OF THE TRANSISTOR.

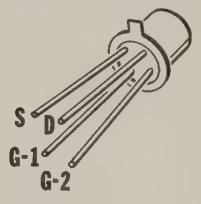
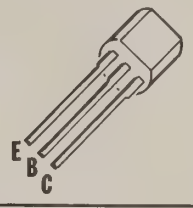
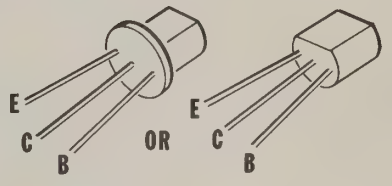
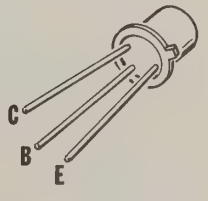
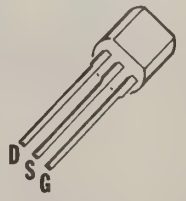
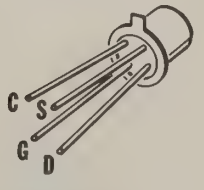
# SEMICONDUCTOR IDENTIFICATION CHARTS

## DIODES

| COMPONENT | HEATH PART NUMBER | MAY BE REPLACED WITH | IDENTIFICATION |
|---|---|---|---|
| D1, D2<br>D301, D302, D303, D304 | 57-27 | 1N2071 SILICON | NOTE: HEATH PART NUMBERS ARE STAMPED ON MOST DIODES.<br>  <br> |
| D8,<br>D9, D10, D11,<br>D12, D13, D14,<br>D15 | 56-24 | 1N458 | |
| D3, D4, D5, D6, D7, | 56-56 | 1N4149 | |
| D401 | 56-26 | 1N191 | |
| VD1 | 56-632 | MV1404 | |
| ZD201 | 56-54 | VRS-5A | |
| LED201 | 412-79 | TIL209 |  <br> |

MPS6520 replace 2N5770 at Q17 & Q18

## TRANSISTORS

| COMPONENT | HEATH PART NUMBER | MAY BE REPLACED WITH | IDENTIFICATION |
|---|---|---|---|
| Q1, Q2, Q3, Q21 | 417-240 | 40673 |   |
| Q4, Q16, Q17, Q18 | 417-134 | MPS6520 |   |
| Q15, | 417-172 | MPS6521 | |
| Q5, Q6, Q7, Q8, Q9, Q10, Q13 | 417-118 | 2N3393 |   |
| Q11 | 417-201 | X29A829 | |
| Q14 | 417-222 | 2N5308 | |
| Q12, Q22, Q23, Q24, Q25 | 417-154 | 2N2369 |   |
| Q26 | 417-850 | 2N5913 OR PT8831 | |
| Q19 | 417-169 | MPF105 |   |
| Q20 | 417-167 | UC734 |   |

# EXPEDITED PARTS ORDER FORM

(FOR REPAIR PARTS ONLY)

PLEASE DO NOT WRITE IN THIS SPACE

NAME _____

ADDRESS _____

CITY _____ STATE _____ ZIP _____

SEND TO: **HEATH COMPANY**
BENTON HARBOR,
MICHIGAN 49022
**ATTN PARTS REPLACEMENT**

| KIT MODEL | PURCHASE DATE | INVOICE NUMBER | LOCATION PURCHASED |
|---|---|---|---|
| | | | |

| QTY. | HEATH PART NUMBER | DESCRIPTION OF PART | PRICE | TOTAL PRICE | DESIRED METHOD OF SHIPMENT |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| | | | | | EDITORS INITIALS |
| | | | | | |
| | | | | | |

**INSTRUCTIONS:**

- INCLUDE CHECK OR MONEY ORDER FOR TOTAL PARTS ORDERED ADD 10% (MINIMUM $0.25) FOR INSURANCE, POSTAGE AND HANDLING.
- AUTHORIZE PERMISSION FOR C.O.D. SHIPMENT (MINIMUM ORDER SHIPPED C.O.D. IS $10.00).
- MICHIGAN RESIDENTS ADD 4% SALES TAX

C.O.D. AUTHORIZATION

_____
SIGNED

THIS FORM IS FOR U.S. CUSTOMERS ONLY. OVERSEAS CUSTOMERS SEE YOUR DISTRIBUTOR.

CUT ALONG DOTTED LINE


# EXPEDITED PARTS ORDER FORM

(FOR REPAIR PARTS ONLY)

PLEASE DO NOT WRITE IN THIS SPACE

NAME _____

ADDRESS _____

CITY _____ STATE _____ ZIP _____

SEND TO: **HEATH COMPANY**
BENTON HARBOR,
MICHIGAN 49022
**ATTN PARTS REPLACEMENT**

| KIT MODEL | PURCHASE DATE | INVOICE NUMBER | LOCATION PURCHASED |
|---|---|---|---|
| | | | |

| QTY. | HEATH PART NUMBER | DESCRIPTION OF PART | PRICE | TOTAL PRICE | DESIRED METHOD OF SHIPMENT |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| | | | | | EDITORS INITIALS |
| | | | | | |
| | | | | | |

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C.O.D. AUTHORIZATION

_____
SIGNED

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# EXPEDITED PARTS ORDER FORM

(FOR REPAIR PARTS ONLY)

NAME

ADDRESS

CITY _____ STATE _____ ZIP _____

| QTY. MODEL | PURCHASE DATE | INVOICE NUMBER | LOCATION PURCHASED |
|---|---|---|---|
| | | | |

| QTY. | DESIRED PART NUMBER | DESCRIPTION OF PART | PRICE | TOTAL PRICE | DESIRED METHOD OF SHIPMENT |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| | | | | | EDITOR'S INITIALS |
| | | | | | |
| | | | | | |
| | | | | | |

INSTRUCTIONS:

- INCLUDE CHECK OR MONEY ORDER FOR TOTAL PARTS ORDERED PLUS TAX
- MINIMUM $5.00 FOR INSURANCE, POSTAGE AND HANDLING.
- ALLOW EXTRA TIME FOR C.O.D. SHIPMENT (MINIMUM ORDER $10.00 C.O.D. IN STATE)
- MICHIGAN RESIDENTS ADD 4% SALES TAX

C.O.D. AUTHORIZATION

SIGNED

NEATH COMPANY
SKYTOP HARBOR,
MICHIGAN 49707
ATTN PARTS REPLACEMENT

PLEASE DO NOT WRITE IN THIS SPACE

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CUT ALONG DOTTED LINE


# EXPEDITED PARTS ORDER FORM

(FOR REPAIR PARTS ONLY)

NAME

ADDRESS

CITY _____ STATE _____ ZIP _____

| QTY. MODEL | PURCHASE DATE | INVOICE NUMBER | LOCATION PURCHASED |
|---|---|---|---|
| | | | |

| QTY. | DESIRED PART NUMBER | DESCRIPTION OF PART | PRICE | TOTAL PRICE | DESIRED METHOD OF SHIPMENT |
|---|---|---|---|---|---|
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| | | | | | EDITOR'S INITIALS |
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| | | | | | |
| | | | | | |

INSTRUCTIONS:

- INCLUDE CHECK OR MONEY ORDER FOR TOTAL PARTS ORDERED PLUS TAX
- MINIMUM $5.00 FOR INSURANCE, POSTAGE AND HANDLING.
- ALLOW EXTRA TIME FOR C.O.D. SHIPMENT (MINIMUM ORDER $10.00 C.O.D. IN STATE)
- MICHIGAN RESIDENTS ADD 4% SALES TAX

C.O.D. AUTHORIZATION

SIGNED

NEATH COMPANY
SKYTOP HARBOR,
MICHIGAN 49707
ATTN PARTS REPLACEMENT

PLEASE DO NOT WRITE IN THIS SPACE

THIS FORM IS FOR U.S. CUSTOMERS ONLY. OVERSEAS CUSTOMERS SEE YOUR DISTRIBUTOR

# CUSTOMER SERVICE

## REPLACEMENT PARTS

If you need a replacement part, please fill in the Parts Order Form that is furnished and mail it to the Heath Company. Or, if you write a letter, include the:

- **Part number** and **description** as shown in the **Parts List.**
- Model number and Series number from the blue and white label.
- Date of purchase.
- Nature of the defect.

**Please do not return parts** to the factory unless they are requested. Parts that are damaged through carelessness or misuse by the kit builder will not be replaced without cost, and will not be considered in warranty.

Parts are also available at the Heathkit Electronic Centers listed in your catalog. Be sure to provide the Heath part number. Bring in the original part when you request a warranty replacement from a Heathkit Electronic Center.

NOTE: Replacement parts are maintained specifically to repair Heathkit products. Parts sales for other reasons will be declined.

## TECHNICAL CONSULTATION

Need help with your Heathkit? . . . . Self-Service? . . . . Construction? . . . . Operation? . . . . Call or write for assistance. You'll find our Technical Consultants eager to help with just about any technical problem except "customizing" for unique applications.

The effectiveness of our consultation service depends on the information you furnish. Be sure to tell us:

- The Model number and Series number from the blue and white label.
- The date of purchase.
- An exact description of the difficulty.
- Everything you have done in attempting to correct the problem.

Also include switch positions, connections to other units, operating procedures, voltage readings, and any other information you think might be helpful.

**Please do not send parts for testing,** unless this is specifically requested by our Consultants.

Hints: Telephone traffic is lightest at midweek. . .please be sure your Manual and notes are on hand when you call.

Heathkit Electronic Center facilities are also available for telephone or "walk-in" personal assistance.

## REPAIR SERVICE

Service facilities are available, if they are needed, to repair your completed kit. (Kits that have been modified, soldered with paste flux or acid core solder, cannot be accepted for repair.)

**If it is convenient, personally deliver your kit to a Heathkit Electronic Center. For warranty parts replacement, supply a copy of the invoice or sales slip.**

If you prefer to ship your kit to the factory, attach a letter containing the following information directly to the unit:

- Your name and address.
- Date of purchase.
- Copies of all correspondence relevant to the service of the kit.
- A brief description of the difficulty.
- Authorization to return your kit C.O.D. for the service and shipping charges. (This will reduce the possibility of delay.)

Check the equipment to see that all screws and parts are secured. (Do not include any wooden cabinets or color television picture tubes, as these are easily damaged in shipment.) Place the equipment in a strong carton with at least THREE INCHES of *resilient* packing material (shredded paper, excelsior, etc.) on all sides. Use additional packing material where there are protrusions (control sticks, large knobs, etc.). If the unit weighs over 15 lbs., place this carton in another one with 3/4" of packing material between the two.

Seal the carton with reinforced gummed tape, tie it with a strong cord, and mark it "Fragile" on at least two sides. Remember, the carrier will not accept liability for shipping damage if the unit is insufficiently packed. Ship by prepaid express, United Parcel Service, or insured Parcel Post to:

Heath Company
Service Department
Benton Harbor, Michigan 49022

HEATH

Schlumberger

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